



# Global City Teams Challenge

**National Building Museum  
Washington, DC • June 1, 2015**



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# **Global City Teams Challenge 2015**

**February 2016**

**Final Report**



# Acknowledgements

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Many thanks to all those who participated in the series of events sponsored under the Global City Teams Challenge. The kickoff event was held in September 2014 at the National Institute of Standards and Technology (NIST), as a collaborative effort with US Ignite. The enormous success of that event led to an exciting Tech Jam in February 2015, which created incredible momentum for over 30 projects to foster the use of smart technologies and systems across the globe. At the June 2015 EXPO, over 60 projects were demonstrated to the public, with over 1500 people in attendance.

The organizers of the Global City Teams Challenge EXPO also wish to thank the Netherlands Embassy for their active support of that event and their interest in promoting the Global City Teams Challenge in Europe and across the globe.

The presentations, discussions, and networking that took place at these events provide the foundation for this report. Special thanks are extended to the organizers listed below. A complete list of speakers is provided in Appendix C.

## **Organizers**

Chris Greer, Director of the Smart Grid and Cyber-Physical Systems Program Office, NIST

Sokwoo Rhee, Associate Director of Cyber-Physical Systems Program, NIST

Joe Kochan, US Ignite

Bill Maguire, US Ignite

Glenn Ricart, US Ignite

Special thanks are due to the Energetics Incorporated team who provided support for event planning and facilitation and prepared this summary report.

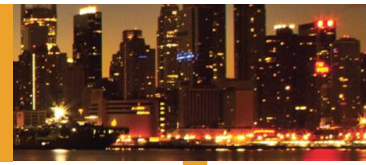


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# INTRODUCTION

The Global City Teams Challenge (GCTC) is an exciting initiative led by the National Institute of Standards and Technology (NIST). It is designed to advance the deployment of the Internet of Things (IoT) and associated cyber-physical systems (CPS) within smart city and smart community environments across the globe. Over 60 teams encompassing 50 cities within the United States and other countries participated in the 2015 GCTC, deploying projects related to public safety, healthcare, energy, transportation, education, and urban planning.

Today, many smart community efforts are isolated and relatively customized, with inadequate consideration for future upgradability and expansion. In the long run this leads to increased cost and inefficiency. GCTC's projects demonstrate self-sustainable, replicable and scalable models for deployment of interoperable, adaptable and configurable CPS and IoT solutions to help cities and communities realize the benefits of smart, interconnected technologies.. To create viable demonstrations, GCTC facilitates partnerships and interconnections among:

- Cities/communities, planners, and project managers – to identify common issues;
- Innovators to form and incubate teams – to address specific issues and provide tangible results; and
- Cities, communities and innovators through “Action Clusters” – to coalesce ideas on issues to be addressed and jointly identify solutions that are scalable and replicable.

This report summarizes the 2015 GCTC, including the key events, goals, and outcomes from the challenge's first round, and introduces the second round, which will culminate in June 2017. The following information, written for cities and innovators interested in the GCTC, smart city efforts and IoT/CPS technology, explains the benefits of a collaborative approach for all parties.

## Cyber-Physical Systems and the Internet of Things

Robots, intelligent buildings, implantable medical devices, cars that drive themselves – these are all examples of cyber-physical systems (CPS). Today, CPS can be found in such diverse industries as aerospace, automotive, energy, healthcare, manufacturing, infrastructure, consumer electronics, and communications. Everyday life is becoming increasingly dependent on CPS – in some cases with dramatic improvements.

Cyber-Physical Systems or “smart” systems are co-engineered interacting networks of physical and computational components<sup>[1]</sup>. A large segment of CPS are increasingly becoming highly interconnected and online – many refer to such systems as the ‘Internet of Things’ or IoT. The IoT describes a network of physical objects embedded with electronics, software, sensors, and connectivity that allows the exchange of data with multiple entities and other connected devices. The focus of IoT is often more on sensing and connectivity, compared with CPS, which puts more emphasis on reliability, security, and system control. The use of such technologies will enable cities and communities to get ‘smarter’ – that is, improve services, promote economic growth, and enhance quality of life. With 54 percent of the world's population now living in cities<sup>[2]</sup>, the development of “smart cities” and “smart communities” is becoming a major focus around the globe.



<sup>1</sup> <http://www.nist.gov/cps/>

<sup>2</sup> <https://www.un.org/development/desa/en/news/population/world-urbanization-prospects.html>



## Global City Teams Challenge EXPO

The Global City Teams Challenge is an expansion of the successful SmartAmerica Challenge, which ran from December 2013 through June 2014. The SmartAmerica Challenge brought together more than 100 companies, universities, and other organizations to form teams that developed and applied networked technologies. This successful effort demonstrated that these technologies have the potential to create jobs and business opportunities and provide socio-economic benefits. The GCTC extends the breadth and depth of these innovative programs to countries and cities around the world, and encourages widespread deployment of important CPS and IoT technologies. More information on prior SmartAmerica Challenge activities and the original teams is found at <http://www.nist.gov/cps/sagc.cfm>.

### 2015 Core Partners in the Global City Teams Challenge

National Institute of Standards and Technology

US Ignite

National Science Foundation (NSF)

International Trade Administration (ITA)

U.S. Department of Transportation (DOT)

IBM, Intel, Qualcomm, Cisco, AT&T, GE, Juniper Networks, Extreme Networks

The teams participating in the GCTC go through a development and roll-out process that occurs over about nine months. During that time, Action Clusters are formed and adjusted, projects are refined, and demonstrations are ultimately planned and executed. The projects are described in more detail in the chapter on GCTC Action Clusters.

The core partners in the GCTC include a range of government agencies and private sector organizations. In addition, there are more than 200 organizations participating in Action Clusters. These include representatives from U.S. cities and states, major cities in other countries, government agencies, private companies, non-profits, universities, hospitals, and a variety of municipal-focused organizations.

A multitude of economic sectors are also represented – from healthcare to information technology and communications, to energy, transportation, public safety, and defense. Additional information on partners and team members can be found at the US Ignite website at [www.globalcityteams.org](http://www.globalcityteams.org).



Participants visit the Amsterdam Smart City exhibit at the Global City Teams Challenge EXPO.  
Photo Courtesy NIST.





## EVENTS

Three events were held to form and refine ideas for the Global City Teams Challenge and ultimately demonstrate concepts. Each event played a unique role in the successful creation of project teams that will facilitate the use of smart technologies and systems in cities across the globe.

### GLOBAL CITY TEAMS CHALLENGE KICKOFF

The first event, held on September 29-30, 2014 at the NIST Gaithersburg, Maryland campus, kicked off the Global City Teams Challenge with inspiring speakers and networking opportunities. The event was a collaborative effort between NIST and US Ignite, an organization that fosters the development of next-generation gigabit applications.

As the first major GCTC event, the goal was to promote team formation and provide teams with the resources and expertise necessary to succeed. The conversations and networking during this event were the most important outcomes of the kickoff. These initial discussions led to the formation of concrete project teams focused on creating some of the most innovation concepts in smart cities and communities. The momentum generated during the kickoff gained speed and grew during the rest of the challenge.

Speakers focused on how CPS and the Internet of Things can work together to create smart communities. Speakers included key officials from the White House Office of Science and Technology Policy, NIST, U.S. Department of Transportation, International Trade Administration, National Science Foundation, National Institutes of Health, and U.S. Department of Energy. Representatives from local Montgomery County, Maryland also presented some insights about building successful and sustainable partnerships for investing in future smart cities and IoT, based on their ongoing work in public safety. A complete list of speakers is provided in Appendix C.

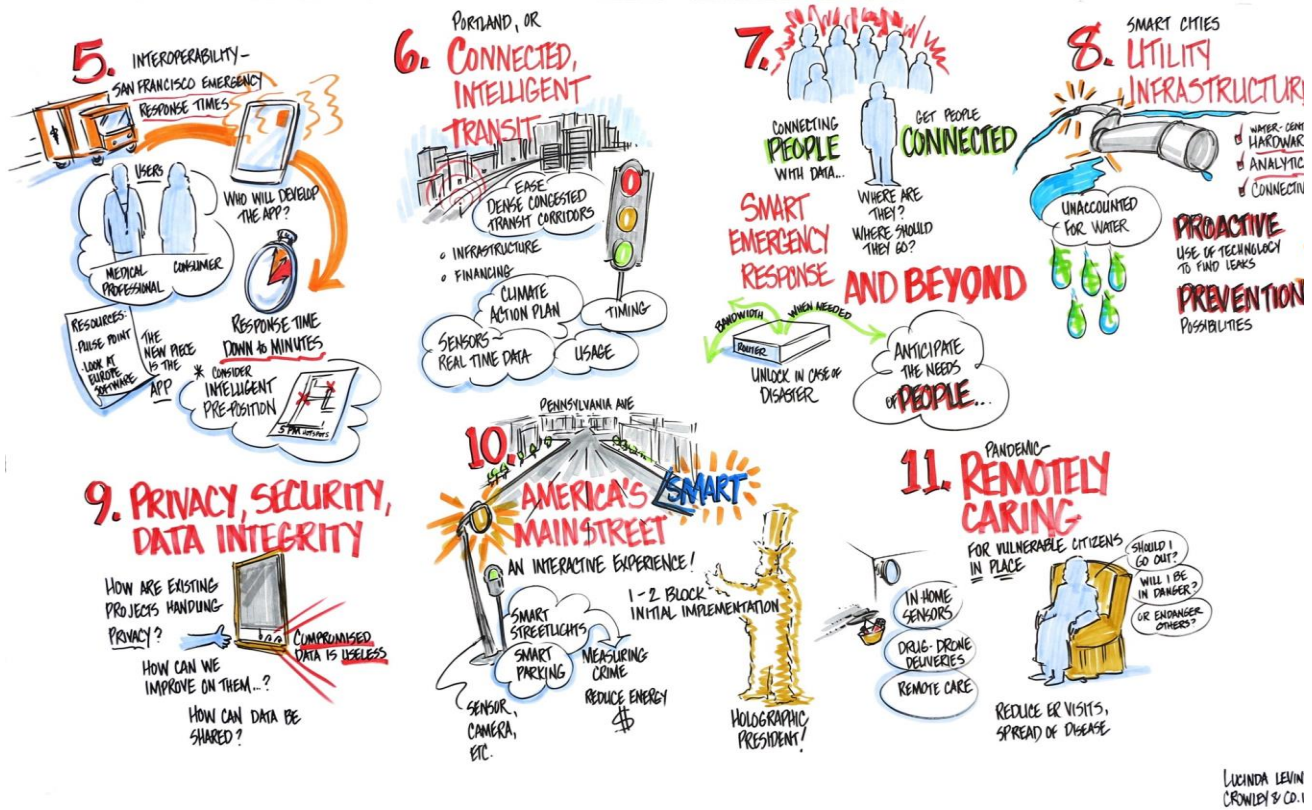
Breakout sessions were an important part of the event. Participants were asked to offer their ideas and identify scenarios and potential partners for future Global City Teams in breakout sessions focused around specific domains, including air quality, traffic management, energy and renewable/green technologies, microgrids, emergency response/disaster resilience, building design/efficiency, manufacturing, healthcare, security, and many others. To kick off the breakout sessions, core partners (Intel, IBM, Juniper, ARM Holdings, GE, Cisco, and Qualcomm) presented some of their ideas on opportunities for smart interconnections of CPS and IoT.

This event initiated the formation of new teams, and built on teams that were created during the prior SmartAmerica Challenge initiative. 16 initial GCTC teams were created covering a multitude of domains, from connected transit to caring for vulnerable populations. During the report-outs, the fledgling teams provided a snapshot of their

#### Global City Teams Challenge Kickoff at a Glance

- Plenaries with inspiring speakers focused on Federal and local initiatives in smart communities and the IoT and investing in future smart cities
- Breakout sessions to uncover scenarios for future smart Global Cities, with kickoffs by partners from Intel, IBM, Juniper, ARM Holdings, GE, Cisco, and Qualcomm
- Networking and team formation sessions to create initial projects and partners for future Challenge demonstrations

potential projects, which were captured by a visual facilitation artist. Some examples of the project team visuals are illustrated below.



## Visual Facilitation from the Global City Teams Challenge Kickoff

Art Courtesy Crowley & Company, L. Levine.

Following the kickoff, an additional 18 teams formed before the next GCTC event. NIST and US-Ignite worked closely with teams to identify additional partners and help develop and prepare projects. In many cases, NIST's experts provided technical guidance on the projects to help with the transition from problem statement to creation of a working solution to tackle that problem.



## GLOBAL CITY TEAMS CHALLENGE TECH JAM

Following the kickoff, a Tech Jam was held on February 12-13, 2015, hosted by NIST and US Ignite. At this event, existing teams were given an opportunity to present their project plans and identify additional project partners. The Tech Jam also provided an opportunity for those with a new project idea to identify partners and develop a new Action Cluster. More than 250 people attended the Tech Jam; representatives of 34 existing teams presented and several new Action Clusters were created during the well-received working sessions.

The event was kicked off with high-profile keynote speakers, plenaries, and panels where Action Cluster participants provided overviews of emerging project concepts and progress being made. During the event, teams networked, refined their ideas, sought out additional partners, and finalized plans for practical, scalable demonstrations. A complete list of speakers is provided in Appendix C.

An interesting outcome of the Tech Jam was the emergence of some of the key domains and sectors with highly feasible interconnections of CPS and IoT and long-lasting benefits to the nation. These included:

- Disaster Resilience
- Transportation
- Healthcare
- Public Safety
- Energy and Utilities
- Education

The Tech Jam provided momentum for GCTC Action Cluster teams to work toward finalizing their projects for the GCTC EXPO in June 2015. It also served as the catalyst for the formation of many new teams and renewed interest from many international participants and governments.

### Global City Teams Challenge Tech Jam at a Glance

- Keynotes from the White House Office of Science and Technology Policy and O'Reilly Media
- Plenary sessions on smart city opportunities with speakers from federal agencies, local governments, and foreign nations (Netherlands, Israel)
- Action Cluster panels with partners providing overviews on current/future work, partners needed, expected outcomes, and challenges
- Breakout sessions to refine action plans, metrics, and demonstration plans
- Networking to recruit new team members and create public-private partnerships



Photo Courtesy DPC.





### GLOBAL CITY TEAMS CHALLENGE EXPO

GCTC 2015 culminated at the Global City Teams Challenge EXPO, held on June 1, at the National Building Museum in Washington, DC. More than 60 teams exhibited and presented in partnership with more than 50 municipal governments around the world, including the United States, Europe, Asia and the Middle East. The teams demonstrated innovative, collaborative projects that help solve real challenges in their communities—with multiple benefits to health, safety, energy, education, the economy, and quality of life.

The EXPO highlighted GCTC's overarching goal: promoting the development of smart global communities that take advantage of next generation Internet of Things technology enabling greater connectivity with cyber-physical systems. The event included keynotes by top U.S. and foreign government officials and dignitaries, with a special visit from the King and Queen of the Netherlands. The Netherlands has been a leader in developing ways to use technology to improve the efficiency and sustainability of urban life.



*Under Secretary of Commerce for Standards and Technology Willie May joins Their Majesties, King Willem-Alexander and Queen Maxima of the Netherlands at the GCTC EXPO. Photo Courtesy NIST.*

#### Global City Teams Challenge EXPO at a Glance

- Keynotes from top government officials and dignitaries from other nations
- Demonstrations and presentations from 63 teams in partnership with 50 municipal governments from the United States, Europe, Asia, and the Middle East
- Participation of more than 17 mayors/deputy mayors, governors, and CTO/CIOs of cities
- Participation from over 200 organizations
- About 1500 registered attendees, including smart cities experts, CPS/IoT stakeholders, cities, communities, federal and foreign governments, industry and academia
- Over 50 media outlets represented from around the world
- Held at America's leading cultural institution for the history of the built environment and magnificent landmark, the National Building Museum

EXPO attendees watched live demonstrations of practical smart global city solutions, such as autonomous robots that can assist during disaster operations, sensor networks for city water systems to detect leaks, and a senior living facility in Montgomery County, Maryland that detects hazards, such as toxic gases and water contaminants, and monitors medical devices such as heart monitors and oxygen machines to keep residents safe.



Second story view of the Global City Teams Challenge EXPO at the National Building Museum in Washington, DC. Photo Courtesy NIST.

The venue for the EXPO, the National Building Museum, is located in the heart of Washington, D.C. The museum is America's leading cultural institution devoted to the history and impact of the built environment. Two speaker stages and over 60 exhibits were uniquely positioned to take advantage of the outstanding architecture of the building and ensure optimal acoustics, flow, and engagement. The event was staged during public hours of the museum, which contributed to its success and accessibility.

## EXPO Participating Cities/Communities

### United States

- Flagstaff, AZ
- Portland, OR
- Annapolis, MD
- San Jose, CA
- North Branford, CT
- Newark, DE
- Charlotte, NC
- Greenville, SC
- Ammon, ID
- Chicago, IL
- Montgomery County, MD
- Boston, MA
- Pittsburgh, PA
- Oakland, CA
- Alexandria, VA
- Arlington County, VA
- Stillwater, OK
- Columbus, OH
- Cleveland, OH
- Chattanooga, TN
- New York, NY
- Washington, DC
- San Francisco, CA
- Kansas City, MO
- Nashville, TN
- Austin, TX
- Denton, TX
- Fairfax, VA
- Seattle, WA
- Madison, WI
- Tampa, FL
- Las Vegas, NV
- Los Angeles, CA
- Baltimore, MD
- Chicago, IL

### Europe, Asia and the Middle East

- Amsterdam, Eindhoven, Nijmegen (Netherlands)
- Genoa, Milan and Assisi (Italy)
- Koblenz (Austria)
- Coruna, Valencia (Spain)
- Tel Aviv (Israel)
- Bandung (Indonesia)
- Guatemala City (Guatemala)
- Greenwich (UK)
- Singapore
- Berlin (Germany)





## Global City Teams Challenge EXPO

### EXPO Sessions and Events

#### *Morning Opening Plenary*

- **Welcome: Willie May**, Director, National Institute of Standards and Technology (NIST), and Under Secretary of Commerce for Standards and Technology, welcomed speakers, project teams, and attendees, and served as moderator throughout the day. For more than a century NIST has been closely involved with new technology – and CPS and the IoT are no exception. IoT involves many types of devices that must work together seamlessly, so standards will continue to be crucial. NIST works with many stakeholders to ensure standards are broadly acceptable and based on science. As part of his convening role, Dr. May also led a discussion with mayors, city managers and local chief technology officers to discuss a wide range of exciting activities sponsored by cities of all sizes, and ways to maintain the momentum generated at the EXPO through sharing of lessons learned.
- **Chris Greer**, Director, Cyber-Physical Systems and Smart Grid Program Office, NIST, spoke about the role of NIST and the diversity of stakeholders participating in the event, including all sizes and types of cities, communities, companies, non-profits, and universities. NIST plays a key role in the underlying standards and measurement science that make smart CPS technologies possible. NIST is leading development of a CPS framework to provide a methodology for designing, building, and validating complex cyber-physical systems at all scales. This work will next be extended to develop a Smart Cities Framework that addresses standards and measurement challenges in the deployment of IoT and CPS technologies for safe, secure, and vital cities and communities. Dr. Greer also noted the amazing innovations presented at the EXPO and the many possibilities achievable through these great partnerships. They represent a remarkable array of communities with a vision for the future to incorporate advanced technologies to make cities safer, more secure, more workable, and livable.
- **Sokwoo Rhee**, Associate Director of Cyber-Physical Systems Program, NIST, provided an overview of the GCTC genesis, approach, scope, and progress to date. As the driving force for the GCTC, Dr. Rhee emphasized the theme of smart innovation for communities – spurred by the collaboration of technology innovators and city leaders. The goal is to establish and demonstrate replicable, scalable, and sustainable models for incubation and deployment of interoperable IoT/CPS technologies and solutions in cities and communities around the globe. The 2015 EXPO demonstrated how IoT technologies could generate real value and benefits.



*Willie May, Director, NIST meeting with mayors, city managers, and CTOs to discuss future activities. Photo Courtesy NIST.*



*Sokwoo Rhee, Driving force behind the GCTC. Photo Courtesy NIST.*



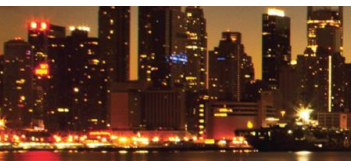
- **Glenn Ricart**, Founder and CTO, US Ignite, noted that cities are the natural laboratories for smart technology applications, since they consume vast resources and contain the technical resources to effectively take action. Exponential growth in sensors, Internet ubiquity, gigabit fiber networks and wireless bandwidth all make cities great labs and test beds for smart-city applications. Cities need to be smarter – and as a result they will reap both economic and societal benefits.

### *U.S. VIP Keynotes and Plenary*

- **Anthony Foxx**, Secretary, U.S. Department of Transportation (DOT), spoke about the importance of smart systems for ensuring safe and efficient transportation. Data tells us we will have 70 million more people over the next 30 years, concentrated in cities. There will be a 45 percent increase in freight over next 40 years. Systems may not be able to keep up—and congestion could start to harm business. Automated and connected vehicles are beginning to change the way we view transport and also raising questions about privacy. The nation will need to adapt. The U.S. has been dramatically underinvesting in transport over many years and support is essential for smart, next generation transportation infrastructure and technology—some is demonstrated here today. We hope that transit is so reliable in 2025 that we all get to work on time, nine out of ten accidents are prevented, and no one has to circle the parking lot. The federal government has an important role—and we need ideas. Everyone can play a role.
- **Tom Kalil**, Deputy Director for Technology and Innovation, Office of Science and Technology Policy (OSTP), Executive Office of the President, the White House, spoke about why the White House is keenly interested in smart cities. First, they see an emergence of technologies with economic and societal value at the city and regional level. Second, people are beginning to use these technologies in ways that create real value. Third, cities and regions are growing in importance; 54 percent of populations now reside in urban environments. Last, a civic technology movement is emerging. Technologists are interested in building a 21<sup>st</sup> century government that is simple, effective and easy to use. The federal government is doing its part by investing in secure and reliable cyber-physical systems, improving the energy efficiency of wireless sensors, and developing big data hubs.
- **NSF Perspectives: Jim Kurose**, Assistant Director of the National Science Foundation (NSF) for the Computer and Information Science and Engineering (CISE), spoke about NSF's role in CPS and motivations behind smart cities. By 2050 it is estimated that two thirds of the world's population will live in urban centers. This rapid growth is causing policy makers and stakeholders to focus attention on urban science to adapt and manage global cities intelligently. A key aspect is embedded systems, devices, and data sources in critical infrastructure – working with and serving people in this environment. Important underlying research areas include CPS and advanced networking. The smart systems we are envisioning today have been enabled in part by NSF's long-standing investments in R&D computer science and engineering. NSF has worked since 2008 to galvanize a community around CPS and fundamental R&D, providing building blocks for many CPS. Many partners are supporting these efforts, including DHS, NASA, NIH, DOT, and others. Advanced networking – powered by secure programmable advanced



*Anthony Foxx, Secretary, U.S. Department of Transportation, delivering a keynote at the GCTC EXPO*



## Global City Teams Challenge EXPO

networks – is a key component. NSF has been pushing the frontiers of advanced networking, which can impact many domains. As we start bringing together multiple sectors and domains—the benefit will multiply exponentially.

### *European VIP Keynotes and Plenary*

- **Honored Guests: Their Majesties King Willem-Alexander and Queen Máxima, The Netherlands**, paid a special visit to the EXPO. They viewed collaborative team demonstrations, met with attendees, enjoyed the many exhibits, and participated in the launch of a new global coalition for smart cities. The efforts of the Netherlands Embassy along with the visit from King Willem-Alexander and Queen Maxima demonstrated their strong support for smart cities and the benefits of public-private collaboration.
- **Master of Ceremonies and European Perspectives: Peter Molengraaf**, Chief Executive Officer, Alliander, introduced dignitaries and team members throughout the morning and provided European perspectives on the importance of smart systems and technologies in their communities. The Netherlands has been developing smart-city applications in Amsterdam since 2009. Since that time they have launched multiple ‘smart’ projects aimed at reducing energy use, improving urban living, and enhancing public safety and recreation.
- **Keynote: Bert Koenders**, Minister of Foreign Affairs, The Netherlands has a strong interest in promoting the GCTC in part because of its complex infrastructure demands, stemming from densely populated cities. Finding smart technology to aid in urban planning and solving water issues is inherently essential for current and future quality of life. CPS and the IoT can help to reinvent cities so they can handle all the issues. Many cities now have expensive, customized solutions that may not be upgradable or lack standards for interoperability. Initiatives like the GCTC will help create a shared framework for these important solutions.
- **Global Smart City and Community Coalition. Bert Koenders**, Minister of Foreign Affairs, The Netherlands, led the launch of the Global Smart City and Community Coalition, an effort of eight cities from around the world. Each city was presented with a symbol of the commitment to the coalition.
- **Eberhard van der Laan, Mayor, City of Amsterdam**, provided a video greeting from Amsterdam. He noted the strong commitment of Amsterdam to smart city initiatives and presented a video reflecting their philosophy.



*Peter Molengraaf, CEO of Alliander, served as Master of Ceremonies*



*Their Majesties King and Queen of the Netherlands at the launch of the Global Smart City and Community Coalition comprised of eight cities: Austin, TX, Chicago, IL, Charlotte, NC, Bandung, Indonesia, Genoa, Italy, and the cities of Amsterdam, Eindhoven, and the Hague of the Netherlands.*

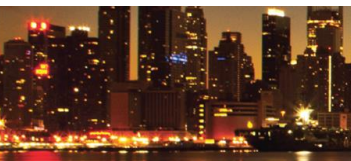


## Action Cluster Teams Presentations

**Table 1. Global City Teams Challenge Action Clusters**

|  |  |
|--|--|
| <b>Disaster/Emergency Response</b> <ul style="list-style-type: none"> <li>• Smart Emergency Response System</li> <li>• Seismic and Infrastructure Monitoring</li> <li>• Human Population Mapping for Enhanced Community Resilience</li> <li>• Cyber Attack-Defense Exercise for Critical Infrastructure Security</li> <li>• Dynamic Virtualization and Intelligent Edge Devices in Disaster Response: Ammon, Idaho</li> </ul>  | <b>Public Safety</b> <ul style="list-style-type: none"> <li>• PA 2040: Washington, DC</li> <li>• Aqueduct Global Flood Analyzer: Amsterdam, the Netherlands</li> <li>• Integrating an Aerial Base Station with a City's Emergency Communication Grid: Denton, TX</li> <li>• Autonomous Notification and Data Collection System: North Branford, CT</li> <li>• Chesapeake Crescent Initiative (CCI) Safe and Smart Cities: Newark, DE</li> </ul>  |
| <b>Healthcare Projects</b> <ul style="list-style-type: none"> <li>• Remotely Caring for Vulnerable Populations during a Pandemic</li> <li>• Ecosystem for Smart Medical Simulation Team Training: Fairfax, VA</li> <li>• Safe Community Alert Network (SCALE): Montgomery County, MD</li> <li>• Geolocated Allergen Sensing Platform (GASP): Chattanooga, TN</li> <li>• People Energy and Buildings: Flagstaff, AZ</li> </ul>  | <b>Energy and Utilities</b> <ul style="list-style-type: none"> <li>• Smart Cities Utility Infrastructure</li> <li>• Intelligent Connectivity and Water Resource Management</li> <li>• Flexible Public Lighting: Amsterdam, the Netherlands</li> <li>• Milan Smart Grid: Milan, Italy</li> <li>• Smart Node</li> <li>• Transform Decision Support Tool: Amsterdam, the Netherlands</li> <li>• Envision Charlotte - Energy, Waste &amp; Water: Charlotte, NC (2 teams)</li> <li>• OpenARMS Residential Solar</li> </ul>  |
| <b>Transportation Projects</b> <ul style="list-style-type: none"> <li>• Applied Robotics for Installations and Base Operations</li> <li>• Intelligent Transit Corridor: Portland, OR</li> <li>• Autonomy-Enabled Shared Vehicles for Mobility on Demand and Urban Logistics</li> <li>• Automated Taxi (A-Taxi) Community Shuttle: Greenville, SC</li> <li>• Hack the Commute: Seattle, WA</li> <li>• Smart Mobile Operation Transportation Hub: Columbus, OH</li> <li>• Transit Hub – Integrated Decision Support System for Public Transportation: Nashville, TN</li> <li>• Smart Mobility: City of Eindhoven, Netherlands</li> <li>• MOOVIT: Tel Aviv, Israel</li> </ul> | <b>City Planning and Development</b> <ul style="list-style-type: none"> <li>• Envision Austin – Mobile Devices for Real-time Data and Resident Feedback: Austin, TX</li> <li>• Lower Manhattan Smart Neighborhood Project: New York, NY</li> <li>• Living Lab Stratumseind 2.0: City of Eindhoven, Netherlands</li> <li>• ParaDrop: Madison, WI</li> <li>• Bandung Command Center for Data Visualization: Bandung, Indonesia</li> <li>• FIWARE City of Valencia Applications (Spain)—City Mobile Application, eGovernment Integrated Platform, Smart City Platform, and Transparency and Open Data Portal</li> <li>• FIWARE We Build City - Open and 3D City Development Platform for Urban Planning: City of Koblenz, Austria</li> <li>• Genoa Smart City Initiative: Genoa, Italy</li> </ul> |
| <b>Arts and Education</b> <ul style="list-style-type: none"> <li>• Bringing Internet of Things Know-How to High School Students</li> <li>• Smart City Educational Network for Autistic Students</li> <li>• Smart Strijp-S: City of Eindhoven, Netherlands</li> <li>• Resource Network for Early Childhood Care and Education</li> <li>• NSF Early Career Workshop Teams (2 teams)</li> <li>• One Community: Cleveland, OH</li> </ul>   | <b>Environment and Sustainability</b> <ul style="list-style-type: none"> <li>• Managing Urban Air Quality</li> <li>• FIWARE Binee Project - Guatemala City (Guatemala)—Smart Bin and App for Rewarding/ Improving Recycling in Cities</li> <li>• Coruña Smart City: Coruña, Spain</li> <li>• Smart Sensing and Smart Emissions (Project Nijmegen): City of Eindhoven, Netherlands</li> </ul>   |





## Global City Teams Challenge EXPO

Table 1. Global City Teams Challenge Action Clusters

| Platforms for the Internet of Things  | Smart Building Infrastructure  |
|---|--|
| <ul style="list-style-type: none"><li>• Link NYC High Quality Wi-Fi: New York, NY</li><li>• Extreme Networks #1: Team UCI DSM</li><li>• Extreme Networks #2: Team MarTech</li><li>• Extreme Networks #3: Team FlowGuard</li><li>• Building a Better City – Streetlights: San Jose, CA</li></ul> | <ul style="list-style-type: none"><li>• Energy Storage based Adaptive Demand Response in Smart Commercial Buildings: New York, NY</li><li>• Cityzenith 5D Smart Physical Infrastructure: San Francisco, CA</li><li>• City of Pittsburgh Plug Load Energy Management</li><li>• PlanIT Impact: Kansas City, MO</li></ul> |
| <b>Tourism and Recreation</b> <ul style="list-style-type: none"><li>• FIWARE Tripstories - City of Assisi, Italy</li><li>• Mobile-first Communication and Service On Demand Infrastructure for Hospitality</li></ul>  |  |

### Action Cluster Session Moderators

**David Maloney, National League of Cities**, introduced presentations describing Action Clusters for disaster response, transportation, IoT Platforms, and urban planning. The National League of Cities is an organization dedicated to advancing the public interest, building democracy and community, and improving quality of life by strengthening local governance and advocating the interests of local communities.

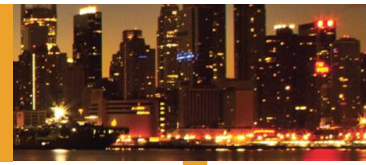
**Deb Socia, New Century Cities**, moderated presentations for Action Clusters related to education and healthcare. Next Century Cities is committed to demonstrating the value and success of communities working to implement gigabit level Internet, while helping other cities to realize the full power of high-speed, affordable, and accessible broadband.

**Sandra Baer, Smart Cities Council**, announced presentations for Action Clusters on urban planning, hospitality, recreation, recycling, and energy and utilities. The Smart Cities Council serves as an advisor and market accelerator, promoting the move to smart, sustainable cities.

**Richard Cooper, U.S. Chamber of Commerce** introduced presentations for Action Clusters on the arts, urban planning, traffic and transit management, urban planning, IoT platforms, the built environment, energy and utilities, and hospitality. The U.S. Chamber of Commerce represents the interests of more than 3 million businesses of all sizes, sectors, and regions in the United States.

**David Leopold, UI Labs, University of Illinois**, moderated presentations for Action Clusters related to public safety, urban planning, disaster resilience, energy and environment, IoT platforms, and transportation. UI LABS is a Chicago-based research and commercialization collaborative that brings universities and industries together to define problems, design partnerships and deliver scalable solutions to future important challenges.





## SUMMARY AND DISCUSSION

The first round of the Global City Teams Challenge fostered the development of more than 60 teams around the world, all working to solve real-world challenges through a collaborative approach to the deployment of smart technologies. This collaborative approach was a different model than the typical city-business relationship, and brought in new partners including the federal government, academic institutions, and non-profits.

This round proved that cities and communities are excited about the potential of this technology, specifically CPS and IoT technologies, and that there are meaningful economic and social benefits resulting from deployments. There is growing momentum in both the public and private sectors to invest in technologies that make governance of local communities simpler, easier, and more effective.

Many urban environments are facing similar challenges due to urbanization and population growth. Intelligent solutions are needed for better ways of governing and managing the many aspects of densely populated communities to ensure quality of life. The promotion of interoperable, scalable, and sustainable technology to address these challenges can increase economic efficiency. NIST's technical expertise and efforts to promote standardization are laying the foundation for the development of such technology, and creating a Smart City model not reliant on one-off or heavily customized approaches.

The applications for CPS and IoT in communities are endless. Some of the most impactful applications are those in disaster resilience, healthcare, public safety, energy and environment, building infrastructure, transportation, urban planning, arts and education, and even recreation and tourism. Every citizen can be positively impacted by smart solutions of CPS and IoT.

NIST's central role in GCTC provided technical guidance to the teams and helped them develop in a sustainable manner. These projects are also helping NIST with its measurement science mission. Specifically, GCTC projects have provided examples to inform the development of CPS and Smart City Frameworks.

While the first round of GCTC was a resounding success, it also demonstrated that future projects should have an increased focus on a few key areas.

- Ensure benefits of technology are measurable, and promote standardization of measurements: 2016 GCTC teams will have to determine the best way to measure the success of their work before deployment. This requirement will help the smart city and community field to better track performance when deploying IoT and CPS technology. At the June 2017 expo culminating this new round of the GCTC, teams will report their performance according to their own standards.
- Promote development of an open, international deployment model: GCTC organizers are promoting the formation of multi-city and multi-country teams working on a similar



## Global City Teams Challenge EXPO

challenge. Such teams can demonstrate best practices for creation of interoperable and replicable technologies.

The 2016 GCTC has already recruited more than 20 teams, some of them working on expanded versions of their 2015 projects, and many more cities and partners are working now to join the challenge. With a longer project timeline in this round – November 2015 to June 2017 – teams will have an excellent opportunity to move this technology forward in an open, collaborative manner, and improve their communities in measurable ways. GCTC is just getting started.



*Global City Teams Challenge exhibitors entertain spectators with smart energy and urban planning systems. Photos Courtesy NIST.*



# APPENDIX A: GLOBAL CITY TEAMS OVERVIEWS

This section describes the Global City Teams Challenge Action Clusters that presented and exhibited at the GCTC EXPO. The information presented here was provided by the teams and is used with their permission.

The over 60 Action Cluster teams at the GCTC EXPO represent the culmination of 9 months of collaborative partnerships that included 50 or more municipal governments around the world, including US, Europe and Asia. All of the projects use next-generation computing and information technologies, such as software-defined networking, local cloud and gigabit to end-user systems, combined with physical equipment and hardware. When fully realized, these innovative interconnections will help to transform the way we live, work, and play.

## TRANSPORTATION

### *Intelligent Transit Corridor: Portland, OR*

A team based in Portland, Oregon is developing a sensor-connected “smart” corridor where transit data, traffic signalization, and air quality sensing are accessible in a data portal with visualization and

analytics to reduce air pollution. The purpose is to identify the effects of traffic signal systems and rapid transit on neighborhood air quality (e.g., particulate dispersion into neighborhoods). The team will explore lower cost sensors to measure air quality and how modeling and analytics can help local government make good transportation policy choices. A first phase test-bed investigated air quality impacts of transit and transportation decision-making in a discrete, wired corridor of Portland known as the Powell Boulevard corridor, which includes a major intra-city highway, the Clinton Street bikeway, and the Division Street development. At the GCTC EXPO, the team showcased their successful test-bed research and resulting analysis related to air quality impacts of transit and transportation decision-making in the Powell Boulevard corridor.



PARTNERS: City of Portland, OR, Intel, Portland State University, Technology Association of Oregon, IBI Group, NetCity and others.

Photo Courtesy DPC.



## Global City Teams Challenge EXPO

### **Smart Mobile Operation Ohio State University Transportation Hub (SMOOTH): Columbus, OH**

Many people in the United States do not live or work close to public transportation (e.g., bus, train, metro). They are often faced with the 'first mile' problem—getting to the bus stop to initiate mobility. Transportation stops are not always close to the last point of interest (e.g., grocery store, mall, pharmacy, work). This creates the 'last mile' problem—how to reach your final destination after you get off the bus. While walking may be a solution for some, it is not viable for everyone (e.g., the elderly, handicapped, parents with small children). The SMOOTH project uses a network of on-demand automated vehicles linked with applications that enable passengers to schedule and track on-demand vehicles using their smartphones. SMOOTH will operate in the city of Columbus, Ohio, with the Ohio State University (OSU) Transportation Hub providing transport between selected stops within the outer campus and automated shuttle driving within the main campus.



*Automated shuttles to bus stops will help an important mobility problem in Columbus.*

**PARTNERS:** City of Columbus, OH, Ohio State University

*Photo Courtesy of Project Team.*

### **Autonomy-enabled Shared Vehicles for Mobility on Demand and Urban Logistics: Boston, MA**

This project aims to address urban transportation and logistics issues by developing a shared vehicle platform called the Persuasive Electric Vehicle (PEV) Platform. The Boston, MA-based team will prototype an autonomous tricycle designed to navigate on bike lanes and reduce transportation delays, noise, emissions, and delivery times for packages and goods ordered online. The PEV platform concept will improve urban transportation through autonomy-enabled vehicle sharing and improve urban logistics by autonomously delivering packages. The PEV platform prototype will use routing algorithms to autonomously navigate the bike lanes. The potential impact of PEV fleets will be demonstrated in simulation studies involving (1) a realistic urban environment; (2) autonomous and manual navigation of the PEV platform; and (3) quantification of the potential impact of PEV fleets.



**PARTNERS:** MIT Media Lab, the MIT Laboratory for Information Decision Systems, the MIT Center for Transportation and Logistics, and the City of Boston

*Photo Courtesy MIT Media Lab.*





## Automated Taxi (aTaxi) Campus Shuttles: Greenville, SC

Autonomous or driverless vehicles may have potential to improve accessibility, reduce travel costs, reduce air pollution, and change how we travel. Greenville County, SC plans to deploy automated



PARTNERS: Greenville County, SC, GCEDC, Project Hub, BJU Robotics Team, Furman TEDx team, Greenville Technical College, Clemson University International Center for Automotive Research, Greenville Automated Transport Coalition, Comet Robotics, Veeo Greenville, Compass Trans Tech, Local Motors, InnoVenture.com, The Vincula Group, and Verdae Development.

Photo Courtesy DPC.

taxi shuttles (aTaxis) as first/last mile solutions in several multi-modal environments. Automated vehicles will be evaluated under various conditions to assess life-cycle costs, performance, reliability, rider receptivity, and usage patterns. This will aid in developing a financially sustainable business model. At the GCTC EXPO, a self-driving “taxi” shuttle called Bruin I was deployed on the lawn of the National Building Museum. Bruin I was activated in 2014 by undergraduate engineering students at Bob Jones University (BJU), who automated a locally assembled Star EV using off-the-shelf technology and demonstrated it in various Greenville locations. In the demo, a rider calls an aTaxi via phone. The driverless aTaxi comes to the rider who boards, selects a stop, and is taken directly and quietly to the destination. The aTaxi then responds to another rider or returns to its mobility hub station. A second pilot test is anticipated at the 1,100-acre GreenVillages planned development.

## Hack the Commute: Seattle, WA

As the country’s fastest growing large city, Seattle is experiencing an increase in traffic and transportation challenges, which cannot be solved by road expansion. Instead the City sought ways



PARTNERS: City of Seattle, Whoa Strategies, Commute Seattle, Microsoft, and Socrata.

Photo Courtesy of Project Team.

to help citizens use data and technology to improve commutes by partnering with several organizations in a program called “Hack the Commute”. The City added more than 150 datasets to its open data platform to encourage development of solutions that help commuters better navigate traffic and encourage the use of different modes of transportation. Of the solutions during the Hack the Commute challenge, “Hackessible” was determined to be the winner and will be featured at the Global City Teams Challenge. This app helps people with mobility challenges plan their routes in Seattle, taking into account their specific accessibility needs. It can be used as an extension to the popular OneBusAway application or as a separate tool. Today, the app allows users to check the terrain around the bus stop for accessibility issues, report obstacles and verify information contributed by other users. The future goal is to allow users to

search for an accessible route based on their preferences.





## Global City Teams Challenge EXPO

### *Transit Hub—Integrated Decision Support System for Public Transportation: Nashville, TN*

The project aims to develop individualized traffic-, event-, and context-aware travel planning simulation for users of public transit services. The resulting intelligent service hub will be accessed via smart applications and will support real-time notifications and alerts to help riders track their routes and potential delays, as well as facilitate information flow (dynamic route demand) from potential riders to transit service providers. A critical aspect of this work is an integrated decision support tool, which allows riders to plan future trips and enables city officials to assess and improve the efficacy of transit options based on models generated from ridership data. This work integrates several data streams generated from sensors including automated vehicle locators, personal smart phones, and beacons. The intelligent service hub will be staged and tested in Nashville, Tennessee. Traffic congestion in this rapidly growing metropolis has nearly doubled in the past decade. It is further challenged by multiple limitations in deploying the types of public mass transportation networks as seen in larger cities. A planned future innovation will be transitioning the system to a hardware device with which all users can interact.



**PARTNERS:** Vanderbilt University, Siemens Corporate Technology, and Nashville Metropolitan Transit Authority.

*Photo Courtesy DPC.*

### *Applied Robotics for Installations and Base Operations*

Applied Robotics for Installation and Base Operations (ARIBO) is a new approach to technology transition for the Army. It is a series of living laboratories that coordinate effort and investment to accelerate the adoption of automated technologies by placing them in useful scenarios where they can safely have a positive impact – today. ARIBO aligns objectives across government agencies and affordably leverages investments in automated ground systems for common goals. This project utilizes automated vehicle pilots to provide data designed to accelerate the adoption and commercialization of UAVs. It combined communication; controls, surveillance, and environmental modeling in autonomous unmanned vehicle systems to help save lives through fast response in warfighting and disaster scenarios. Team ARIBO, sponsored in part by the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC), demonstrated the potential benefits of cyber-physical systems technology, programs and test beds to improve safety, sustainability, efficiency, mobility and overall quality of life. Autonomous systems and autonomy-enabled manned ground platforms are enabling capabilities that provide force multiplication to warfighting functions and to large installations. They help develop an understanding of how to leverage autonomy and autonomous.



**PARTNERS:** Comet Consulting; Greenville, SC; Tampa, FL, Greenwich England, MOSI, DOE-NREL, FHWA, Autonomous Stuff, Harbrick, Hevo, EPFL, Lausanne; U.S. ARMY TARDEC, INDUCT Technologies, UNICOR, Stanford University, Fort Bragg, West Point, CVPC, and UTARI.

*Photo Courtesy of Project Team.*



**PARTNERS:** AutomotiveNL, Brianport Eindhoven, Driven Helmond, Provincie Noord-Holland, TNO, DITCM Innovations, World Resources Institute, Deltares, VU University Amsterdam Institute for Environmental Studies, Utrecht University, and PBL Netherlands Environmental Assessment Agency.

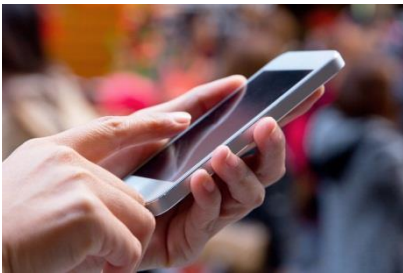
*Photo Courtesy DPC.*

### **Smart Mobility (Living Lab): City of Eindhoven, The Netherlands**

This team showcased efforts to improve the utilization of existing transportation networks and support smart mobility by focusing on deployment and the removal of barriers in order to improve the efficiency of transport systems and meet user demands. Supplementing a model with information via communication systems can generate travel data that people can use to impact mobility. A relatively new area of model development is to optimize the impact of information and model the response of travelers to recommendations. This takes us along the route towards intelligent navigation systems that use these plans to advise the user and the traffic about whether the user should first do the shopping, for instance, or post a package. Depending on how the user responds to the recommendation, the advice may then be modified once more.

### **MOOVIT: Tel Aviv, Israel**

MOOVIT is an app that relies on a mix of user-generated, crowd-sourced updates and transit information from local transit agencies to improve transit planning. The City has embarked on a strategy to leverage its startup infrastructure to develop smart city solutions which improve urban administration, increase transparency, heighten civic engagement, and provide residents with a highly personalized city. As part of the effort to increase accessibility and transparency of information along with civic engagement, municipal databases have also been opened to the public, and competitions have been held in which residents develop mobile apps for public use based on these open databases. One of the winners of the 2012 App2U competition was MOOVIT, a transit planning app based on user-generated, crowdsourced updates and featuring live transit information. MOOVIT's effectiveness stems from its cooperation with a community of riders around the world. Complete transit information from local transit agencies is mixed with real-time data about current times and conditions from other nearby riders



*55 Countries, one App, and Counting*

**PARTNERS:** Tel Aviv Government

*Photo Courtesy DPC.*



### ENERGY AND UTILITIES

#### **Smart Cities Utility Infrastructure: Las Vegas, NV, Los Angeles, CA, Atlanta, GA**

Every year millions of gallons of water are lost through leaks in aged water pipes around the world that date back to the turn of the century. Unaccounted for water is as high as 40% in cities around the world. Little is known about the pipes until leaks are reported, typically above the ground. The project aims to create a non-intrusive and cost-effective approach to better manage aging water pipeline infrastructure and reduce water loss due to leakage. The project will use the AT&T wireless network (LTE), sensors, sounding technology, and smart dashboards to identify water leaks. Sensors placed in the water distribution infrastructure will utilize wireless networks to send information such as pressure, temperature, and leak detection. With the system in place leaks can be proactively located instead of waiting for leaks to be reported. In a similar vein, smart lighting solutions can be used to save energy and address smart city applications. The project will introduce a solution that not only is used for lighting control but also for other applications such as traffic and parking management, video imaging, and asset management. Installation sites include Los Angeles CA, Las Vegas NV and Atlanta.



PARTNERS: AT&T, IBM, Mueller/Echologics, GE, and Captiva.

*Photo Courtesy DPC.*

#### **Intelligent Connectivity and Water Resource Management: Cincinnati, OH**

As global water consumption increases, managing the water resources has become a critical issue. Providing a safe, reliable water supply is a critical driver of health and economic success. The project team developed a “smart pump station” for a waste water system that helps water utilities receive more reliable information, better manage water resources, reduce reactive maintenance, and improve water quality. The project will use machine to machine technology to collect, process, and analyze the state of the water system. The solution will enable Cincinnati to collect actionable information from its water system in a timely manner to improve water quality and facilitate the management of its water resources.



PARTNERS: Qualcomm, CH2M HILL, and City of Cincinnati.

*Photo Courtesy DPC.*

#### **Milan SmartGrid: Milan, Italy**

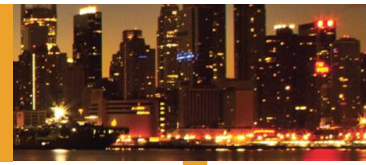
The project team is developing a Smart Grid for power distribution, built with the most modern technologies available today, and an Energy Management System to realize load control, energy flow optimization, integration of renewable energy plants and storage, and lighting management. The Smart Grid is a key component of creating a smart urban community in Milan. Demonstration and deployment of Milan Smart Grid will provide multiple benefits to its citizens, including cost-effective energy, more reliable energy delivery, and greater use of renewables.



PARTNERS: Milan, Italy, and ENEL

*Photo Courtesy DPC.*





PARTNERS: Smart Society Services,  
Municipality of Amsterdam.

Photo Courtesy DPC.

## **Flexible Public Lighting with an Open and Independent Smart City Platform: Amsterdam, The Netherlands**

Public lighting in the Netherlands has been controlled using “Ripple Control”. However, this technology has become obsolete and no longer meets today’s needs and requirements. Moreover, customers would like the ability to control public lighting and not be dependent on one specific supplier. This has led to the development of FlexOVL, a new and flexible switching system of public lighting in The Netherlands, which delivers more control for municipalities and is the first solution powered by the Open Smart Grid Platform. The Platform is an open, generic, scalable and independent ‘Internet of Things’ platform which enables various public service objects to be easily controlled and monitored with any application

and with any communication infrastructure. FlexOVL was tested in 2013 in Amsterdam, and is now being implemented in 150 municipalities. Additional and expanded implementations have been planned.



PARTNERS and Advisors: City of Charlotte, NC, Kingfisher Capital, Bank of America, Wells Fargo, Ernst & Young, Mecklenburg County, Geosyntec, More & Van Allen, Cassidy Turley, University of North Carolina, Charlotte, Duke Energy, Charlotte Center City Partners Itron, CH2M Hill, Charlotte Water, and Verizon. Photo Courtesy DPC.

## **Envision Charlotte - Energy, Waste and Water: Charlotte, NC**

At the GCTC Envision Charlotte showcased its first-of-a kind programs in energy, water, waste and air to conserve resources and reduce operating costs. The primary focus of Envision Charlotte is to reduce energy that is wasted in commercial buildings within Charlotte’s ~2 square mile I-277 inner loop by using innovative technologies to encourage energy efficiency and changes in consumer behavior. The initiative is partnering commercial building owners who control more than 15 million square feet within the inner loop. The initiative will deploy a combination of digital smart grid and building automation technologies, as well as unique energy tracking tools, to provide building owners and office workers with near real-time information about the buildings’ collective energy use. It will also suggest specific actions office workers can take to reduce energy consumption.

### **Smart Node**

The world is filled with data acquired from sensory networks throughout homes, communities, buildings and municipalities. Although the data is often represented in a format suitable for engineers, it is not presented in a usable format for most citizens. The goal of this team is to provide the data in a simple and effective manner that will best equip, engage and inform every citizen. This information will not only be useful and informative, the data may engage citizens to alter their behaviors in positive and sustainable ways (i.e., energy and water usage, transportation, engagement with local government, etc.) The team has completed several prototypes, however, new team members involved in design, understanding of engineering data and data storage/analytics would be instrumental for the completion of the project. At the GCTC the team showcased smartNODE, which provides lighting control to lower energy



smartNODE provides lighting control to reduce energy costs along with wireless IoT infrastructure.

PARTNER: AMP

Photo Courtesy DPC.

costs and wireless gateway infrastructure necessary for existing and planned IoT solutions.



## Global City Teams Challenge EXPO

### *Transform, the Decision Support Tool: Amsterdam, The Netherlands*

Due to technology developments, customer demand and environmental constraints the energy system will be changed fundamentally in the coming decades. The optimal solution to realize future low carbon energy systems is still undefined and therefore needs cooperation of all stakeholders involved. Six European cities and twelve private partners have teamed up to acceleration the transition towards a low carbon energy system. The team developed an energy planning tool that utilizes city, building, and energy data to simulate the impact of multiple low carbon measures (including district heating and retrofitting) on CO<sub>2</sub> emissions, energy consumption, renewables, and costs. By varying data, measures, targets and locations, cities are able to simulate different scenarios, which are completely customized to their city. The aim of the tool is to support private and public stakeholders involved in urban energy planning, undergo a transparent and structured decision making process. The tool serves as a common platform where ideas and proposals can be exchanged and analyzed in a transparent way.



PARTNERS: City of Amsterdam, Accenture, Austrian Institute of Technology, Alliander, ARUP, ARE Liguria, Dong Energy, Hamburg Energie, Siemens, Wien Energie, Hofer, ERDF, Enel Distribuzione, Hespul, DTU, IBA Hamburg, Österreichisches Institut für Raumplanung

*Photo Courtesy DPC.*

### *OpenARMS Residential Solar: Austin, TX*

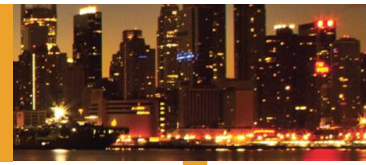
This team showcased efforts to lower residential solar PV and storage install costs significantly and allow home owners to easily set up their own energy hub in their home. The centralized architecture being developed and demonstrated will include multiple operational modes, such as grid-tied PV with power factor correction and ability to sell excess PV to the grid, or storage of local PV generation, or combinations. It will be networkable and resilient, allowing for transactional optimization and control and adaptable to island concepts. The system could transform the economics of distributed renewable energy by enabling a transactional energy ecosystem, lowering barriers to resilient low cost energy, and simplifying residential integration of distributed energy resources.



PARTNERS: Pecan Street, and Alliander.

*Photo Courtesy DPC.*





## SMART BUILDING INFRASTRUCTURE

### *Energy Storage-Based Adaptive Demand Response in Smart Commercial Buildings: New York, NY*

The project aims to develop solutions to provide better energy storage, reduce grid stress, and improve energy efficiency. Novel high performance/low cost batteries can enhance demand response (DR) capabilities of modern Building Automation Systems (BAS). New York-based Urban Electric Power developed rechargeable grid-scale battery systems based on safe and ultra-low cost Zn-MnO<sub>2</sub> chemistry used in household batteries. These batteries decrease peak loads in urban areas and, in conjunction with Siemens' Smart Energy Box, controls optimal system operation, adding a DR brain to more traditional BAS. Columbia University and CUNY provide expertise in regional tariffs and optimal storage dispatch algorithms towards minimized building ownership cost. NY-BEST provides independent testing and advisory, including the context of new REV rules that promote adoption of distributed energy resources in New York City. Currently, large scale applications of cyber physical systems such as BAS can already provide significant DR. However, benefits from a



PARTNERS: Urban Electric Power, Siemens Corporate Technology, Columbia University, CUNY, and NY-BEST.

*Photo Courtesy DPC.*

smarter and more stable grid are ultimately limited by the need to maintain utility and comfort for building occupants. Adding battery storage to such a system alleviates these constraints, thus providing more synergies for smarter grids and integration of renewable energy. Future project plans include pilot demonstrations of the technology in New York City buildings such as large office buildings, mix-used university buildings, and public schools.

### *Cityzenith 5D Smart Physical Infrastructure: San Francisco, CA*

Governments, capital markets, real estate investors, property managers, commercial tenants, and even utilities lack comprehensive, granular, actionable data about potential energy efficiency opportunities and solutions available at the level of individual buildings and tenant spaces. The principal goal of the 5D Smart San Francisco 2030 District Project is to create a single hub that easily provides necessary data and information to San Francisco building owners in order to accelerate and expand investment in energy efficiency retrofits in a cost effective and timely manner. Buildings are responsible for 52% of the City's carbon emissions. 75% of the City's largest 2,000 commercial buildings fall within the boundaries of the 2.2 square mile area of interest. The project maps building energy usage and GHG emissions data to a dynamic, interactive 3D model of downtown San Francisco. Leveraging Cityzenith's ground-breaking 5D Smart City™ data visualization technology, the platform will serve as a collaboration tool for the City's major government agencies, private commercial buildings owners, academic institutions, energy management solutions providers, standards organizations, network and telecommunications companies, and energy retrofit finance firms to accelerate the awareness and adoption of best practices and best-in-class energy management solutions in the industry.



PARTNERS: Berkeley Lab, HELiOS, SEED Platform from U.S. DOE, Verizon, OGC, C40 Cities, CityZenith, SF Environment, Street Light Data, and echoMESH.

*Photo Courtesy DPC.*



## Global City Teams Challenge EXPO

### **Plug Load Energy Management: Pittsburgh, PA**

This team will showcase its deployment of smart plugs on various devices in buildings. The city has installed pilot “smart plugs” which are inserted between a wall outlet and electrical devices and transmit power output data via Wi-Fi to a portal on a mobile device or desktop. Using the plugs and a management system, the city can monitor power consumption in city buildings and determine what devices are top energy users. The user can also turn off power to a particular device remotely – enabling the city and citizens to reduce energy consumption and save money. To date, through a pilot, the city has found that soda vending machines and coffee pots used the most electricity. When power to those devices was managed through smart plugs, it saved the city money. The city is looking at a 50 percent average in savings using plug load controls year over year.



**PARTNERS:** City of Pittsburgh, Boss Controls, and Carnegie Mellon University.

*Photo Courtesy DPC.*

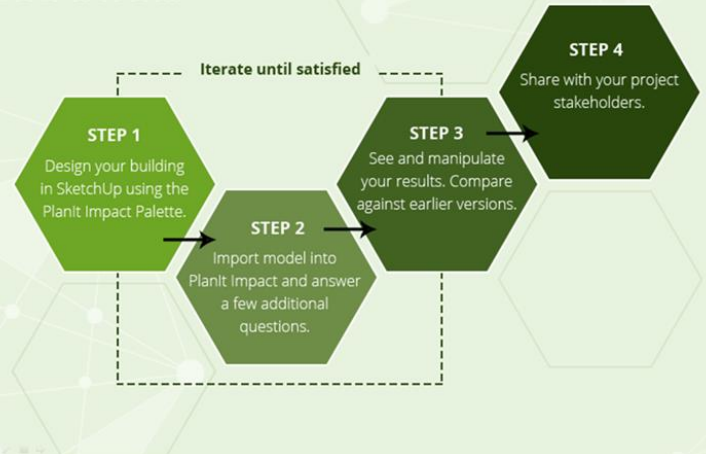
### **PlanIT Impact: Kansas City, MO**

The U.S. building sector (i.e., commercial, residential and industrial buildings) accounts for almost as much energy use and CO<sub>2</sub> emissions as the industrial and transportation sectors combined.

Moreover, the United States leads the world in the average annual water usage per capita. Capitalizing on emerging opportunities like Open Data and gigabit Internet speed, PlanIT Impact was designed to simulate building or site performance factors (e.g., energy and water use, storm water retention, proximity to public transportation, potential ROI) during the early stages of the design process.

Architects, planners and other stakeholders first create a site specific 3D model in SketchUp. The model is then imported into the PlanIT Impact web application, which combines the model with data from Open Data sources such as National Oceanic and Atmospheric Administration (NOAA), US Census Bureau, Department of Energy, and walkscore.com. PlanIT Impact calculates real-time projections about how the conceptual design will perform when it's built. The conceptual design can be modified to understand how design iteration will perform. With an average minimum lifespan for buildings of 50 years, design decisions can have long-term impacts on the environment and economy.

#### How It Works



**PARTNERS:** PlanIT Impact, Kansas City MO, Mozilla Foundation, and KC Digital Drive.

*Art Courtesy of Project Team.*



## DISASTER AND EMERGENCY RESPONSE

### Smart Emergency Response System: Denton, TX

The success of emergency response operations critically relies on the efficiency of emergency communication infrastructure. In emergency scenarios, the fixed information infrastructure may be destroyed, may not meet the surge of demand, or may not exist at all. In such situations, an on-demand communication infrastructure is critical for the success of emergency response missions. The Smart Emergency Response System (SERS) uses a flexible, cost-effective, drone-carried, on-demand communication infrastructure integrated with existing emergency management systems to support the missions of first responders, rescue robots, mission command, and control centers. SERS transforms the provision of emergency communication, reduces emergency response time and cost, and save lives. The technology can be used to temporarily establish communication at disaster events where cell-towers are down, at public events where there is a surge of communication demands, and at more frequently encountered small-scale emergency events such as wildfires at wild-land urban interfaces.



PARTNERS: University of North Texas, Worcester Polytechnic Institute, Wright State University, HumanoidWay, MathWorks, Myth Innovations, QBase, Austin Fire Department, Denton County Emergency Services, Emergency Preparedness Department of the North Central Texas Council of Governments, and Air Force Research Lab: TechEdge.

Photo Courtesy DPC.

### Seismic and Infrastructure Monitoring: Oakland, CA

The social and economic impacts of human and natural disasters are huge. The project aims to integrate sensors, data, analytics, intelligence, and automation to present a common operational picture via the seismic and infrastructure monitoring (SIM) web portal. The SIM could help improve planning for and response to events, reduce losses due to disasters, and monitor remote locations with minimal cost implications. The SIM system incorporates sensor driven data measurement, comprehensive assimilation of data from multiple sources, crowd sourced data, artificial intelligence driven predictive analysis, live visualizations via a unified dashboard, and calibrated emergency response based on the situation. Data feeds are provided by USGS, NOAA, NDFD, NASA EOSDIS and others. Future plans include expansion of sensors to multiple locations, collaboration with additional local and federal governments, integration of additional data sources, and integration with existing emergency response systems.



PARTNERS: City of Oakland, Singapore, Berlin, Germany, Bosch, Tech Mahindra, Google, and Industrial Internet Consortium.

Photo Courtesy DPC.

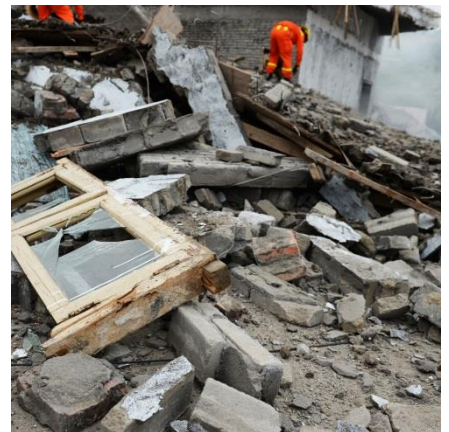




## Global City Teams Challenge EXPO

### *Human Population Mapping for Enhanced Community Resilience: Annapolis, MD*

Understanding the relationships between the human population and the infrastructure systems within a community is a major challenge during disasters. Today civil authorities lack the means to display the network of organizational and social relationships within their communities. These key pieces of situational awareness could inform planning, response, and recovery from disasters and civil emergencies. This project is developing a GIS-based Human Geography Mapping (HGM) system to model the social networks that comprise the civic infrastructure of a community. The goal is to provide government officials, emergency managers, and community leaders with the capability to map the human capital of the community and integrate that information into the existing GIS maps of terrain, built environment, transportation systems, and critical infrastructures. The HGM system will be developed using scalable open standards and be embedded within a Virtual Business Emergency Operations Center. This will support public and private sector collaboration, enhance trusted communications networks, and improve coordination and management of resources. The system will enhance emergency response by understanding relationships of vulnerable populations to local hazards, and via more effective planning for disaster response, flooding control, transportation management, evacuation routing, and ingress and egress of emergency vehicles.



PARTNERS: The Aethna Group, LLC, City of Annapolis, MD, TCecure, Open Geospatial Consortium, University of Louisiana, and MDL Strategic Solutions.

*Photo Courtesy DPC.*

### *Cyber Attack-Defense Exercise for Critical Infrastructure Security*

This team showcased its research related to the cyber security and resiliency of the power grid with a particular focus on the use of attack and defense tools and techniques demonstrating realistic cyber attacks and defenses. The electric power grid is a complex cyber physical system (CPS) that forms the lifeline of modern society. Cyber security and resiliency of the power grid is of paramount importance to national security and economic well-being. CPS security testbeds are enabling technologies that provide realistic experimental platforms for the validation and evaluation of security technologies, the exploration of innovative countermeasures, and the training of government and industry stakeholders and students within controlled environments. This GCTC project, building on the Smart America project, will demonstrate the federation of three cyber security testbeds (i.e., PowerCyber: CPS Security Testbed for Smart Grid, ISERink: Cyber Defense Competition platform, both from Iowa State University and the DETER cyber security testbed from USC/ISI) and cyber security training exercises, with credible and interesting use-case scenarios, for government and industry stakeholders and university students. The integrated testbed platform together with associated tools and training modules will fundamentally transform the cyber security preparedness and response training exercise from the current table-top attack-defense exercise, (called, GridEx conducted by NERC) to a more realistic testbed-based attack-defense exercise that will significantly help to secure the grid against cyber-attacks in the future.



PARTNERS: Iowa State University, Information Science Institute - University of Southern California, Washington State University and various Government and industry stakeholders (e.g., Iowa National Guard, NERC, and Alliant Energy).

*Photo Courtesy DPC.*





## *Dynamic Virtualization and Intelligent Edge Devices in Disaster Response: Ammon, ID*

The objectives of the demonstration are to showcase how virtualization technologies and intelligent edge devices (i.e., sensors, cameras, 2-way communication) can be integrated to improve response times, event management, and outcomes in an active shooter emergency event. A public safety active shooter response system was installed at a Middle School in Ammon, Idaho. Gunshot sensing equipment, IP cameras, and a PSAP monitoring station was connected to a single virtual network which activates automated system responses upon sensing gunfire. A simulated shooting event captured by the gunshot sensing equipment activated system responses, which included geographic location information, shot area imagery, and live IP video streams from system cameras. The system also provided real time event tracking and the ability to forward selected content to first responder mobile or handheld devices as part of dispatch, equipping First Responders with advanced surveillance tools and communications.



PARTNERS: Ammon, ID,  
EntryPoint Networks, DataBuoy,  
Alphacorp Security, Bonneville  
County Sheriff's Department,  
Bonneville Joint School District  
#93; and U.S Air Force -  
Southern Command.

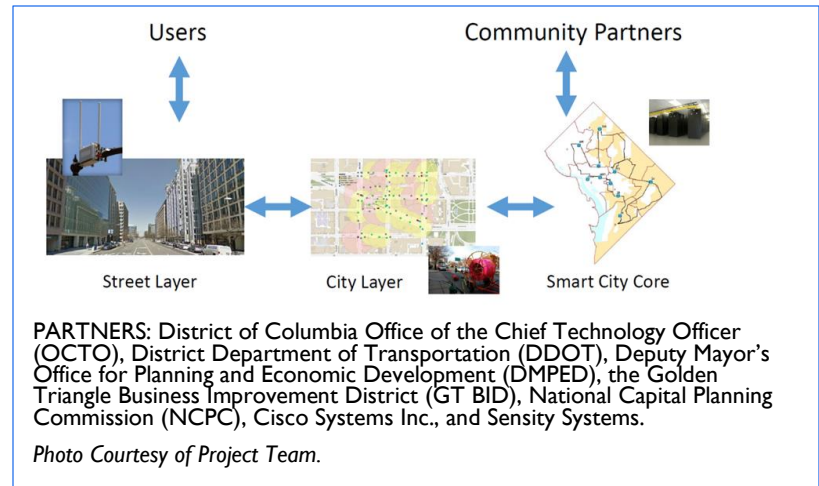
*Photo Courtesy of Project Team.*



### PUBLIC SAFETY

#### PA 2040: Washington, DC

The PA 2040 initiative utilizes wireless service to improve maintenance and transportation management and user experience on the Pennsylvania Ave corridor in Washington D.C. The foundation for the system is envisioned as a pervasive mesh Wi-Fi network. The Wi-Fi will serve to provide free internet access to the public, secure services to public safety entities, and extend connectivity for environmental sensors. In addition, the Light Sensory Network will bring advanced wireless networking, advanced sensors (e.g., video), and edge-based processing of real-time street data to the LED streetlights to solve parking, traffic, public safety, and street operations and maintenance issues on the corridor. A sampling of the capabilities includes wayfinding, parking demand management, improved maintenance response times and emergency response management. Analytics from the public Wi-Fi will also allow for greater information about the origins of corridor visitors to enable a more customized user experience with language options. The analytics could help improve overall planning and programming of the public space.



#### Aqueduct Global Flood Analyzer: Amsterdam, The Netherlands

Floods cause huge damage every year. River floods affect 21 million people on average per year, with a 2.6-fold increase expected by 2030. There are three main characteristics of floods: type (e.g., river flood, storm surge), magnitude (e.g., 100-year flood), and protection (e.g., dams, levees). The team developed the Aqueduct Global Flood Analyzer, which models the risk and impacts of river floods. Modeling of impacts from coastal storm surges are planned for the coming year. Five Global Climate Models from IPCC AR5 were used in projecting future flood risk. Three combinations of flood scenarios were used in the analyzer (i.e., RCP4.5+SSP2, RCP8.5+SSP2, RCP8.5+SSP3). In addition to combined scenarios, estimated future flood risks were estimated separately with climate change scenario only and socio-economic change scenario only. That allowed identification of the driver of the change in future flood risks in any given area. The Aqueduct Global Flood Analyzer is unique because of the ability to measure risks in dollars, the highly customizable nature, the high resolution inundation maps, and the ability to create future projections. Planned future improvements to the analyzer include modeling coastal storm surge risk, estimating actual levels of protection worldwide, and estimating viability, cost, and benefits of protection measures.



**PARTNERS:** Kingdom of the Netherlands, World Resources Institute, Deltares, Universiteit Utrecht, PBL Netherlands Environmental Assessment Agency, and VU University Amsterdam.

*Photo Courtesy DPC.*



## Integrating an Aerial Base Station with a City's Emergency Communication Grid: Denton, TX

This project showcases a deployable aerial base station and a situational awareness tool that work hand in hand to enhance the disaster recovery process during emergency scenarios. An aerial base station bridges the gap in communications caused due to natural and man-made disasters. A



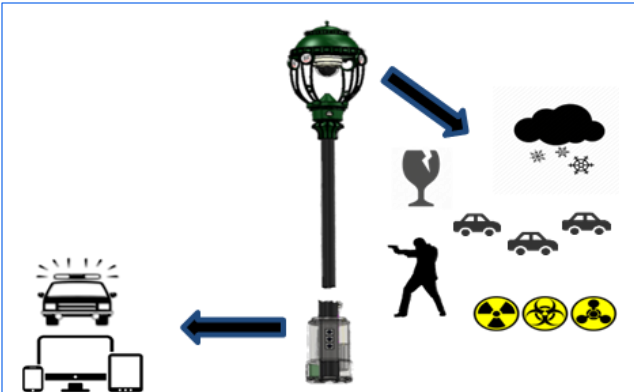
**PARTNERS:** University of North Texas, MIT Lincoln Laboratory, City of Denton, Civil Air Patrol, CyPhy Works, and Dean Skidmore (independent consultant).

*Photo Courtesy DPC.*

situational awareness tool and collaborative architecture (the Next Generation Incident Command System) provides the capability to exchange critical information among the stakeholders including citizens, first responders, and volunteers. This integrated system allows decision-makers to locate disaster victims and supply resources needed in real-time. The system demonstration used a broadband router airlifted by a balloon and/or a small unmanned aircraft system (sUAS). The long term goal of this project is to create the necessary infrastructure to integrate an Aerial Base Station with existing warning and communication networks used by emergency response agencies. This integration will enable citizen to citizen communication and citizen to first responder communication when there are power failures and cell towers are dysfunctional during disaster response.

## Autonomous Notification and Data Collection System: North Branford, CT

Safety and security are of paramount concern for communities across the U.S., and the project team is developing a product that maximizes the existing real estate of their high end decorative street



**PARTNERS:** Penn Globe, Queralt Inc, Eye Lighting, CT Innovations, CT DECD, Remote Reality, CCAT, Workforce Alliance, Town of North Branford, and Shooter Detection Systems.

*Art Courtesy of Project Team.*

lighting poles and fixtures—The Autonomous Notification and Data Collection System. This PennSMART security system is discretely installed within the light fixtures and includes a 360-degree PTZ camera, gunshot sensor, facial recognition, data storage, and an energy saving LED lighting platform. The project will be deployed at a community center that is also adjacent to an elementary school in Penn Globe's hometown of North Branford, Connecticut. Future plans include incorporation of other sensors and technology options that will benefit cities, municipalities, and academic institutions to address issues including but not limited to security, weather, traffic management, and emergency services.



## Global City Teams Challenge EXPO

### *Chesapeake Crescent Initiative Safe and Smart Cities: Newark, DE and Alexandria, VA*

The Chesapeake Crescent Initiative (CCI), a public-private collaborative to support technological innovation, is leading a “Safe + Smart Cities” coalition to help cities optimize their operational performance and harden their resiliency through the efficient use of technology. The partners provide pro-bono expertise and recommendations to the pilot sites through a collaborative framework and multi-step process. Recommendations—provided in the form of a blueprint document—offer pragmatic and feasible options to help visionary urban communities achieve or exceed their “safe and smart” objectives while also increasing global competitiveness, sustaining regional economic growth, and improving citizens’ lives. The Coalition aims to develop a tangible, actionable and comprehensive “safe and smart cities” program that can: improve the overall operations and management of local government, both in the day to day as well as in times of adversity; expand capabilities in urban data collection, analysis, and dissemination; develop beneficial new linkages among community residents; help democratize and expand individual citizens’ participation in government; and create a replicable public-private collaborative model.

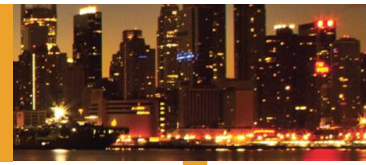
The Coalition is currently engaged in two municipal pilot projects: Newark, DE (in the final stages of the framework) and Alexandria, VA (in the beginning stages of the framework), and intends to select additional municipal pilot sites in the future.



PARTNERS: Federal, state, and local government, Cisco, Schneider Electric, AtHoc, Verint Systems, Priority 5 Holdings, Woodrow Wilson International Center for Scholars, the University of Delaware, Virginia Tech, the University of Maryland, Holland & Knight, and National Standard Finance LLC.

*Photo Courtesy DPC.*





## HEALTHCARE

### *Geo-located Allergen Sensing Platform (GASP): Chattanooga, TN*

A wide range of health outcomes is affected by air pollution. A recent World Health Organization report estimated that, a staggering 7 million people died as a result of air pollution exposure in 2012—one in eight of total global deaths. Airborne particulate matter is a major component of pollution and can adversely affect citizens. Approximately 50 million Americans also suffer from allergies. The Geo-located Allergen Sensing Platform (GASP) combines cyber-physical systems (CPS) and gigabit networks to address major health concerns due to air pollution. GASP is deploying an array of in-situ sensors within Chattanooga, TN to comprehensively characterize air quality in real time by streaming location, temperature, pressure, humidity, abundance of 6 pollutants (i.e., O<sub>3</sub>, CO, NO, NO<sub>2</sub>, SO<sub>2</sub>, and H<sub>2</sub>S), and airborne particulates (0.5-40 µm), both pollen-sized and smaller. This first of a kind integrated in-situ sensor package for tracking pollution and pollen will enable airborne particulate mapping for Chattanooga, TN. Longer term, these tools could support a nation-wide, open access dissemination platform.



PARTNERS: UTD, The University of Tulsa, The Public Library, epb fiber optics, and The Enterprise Center.

Photo Courtesy of Project Team.

### *Ecosystem for Smart Medical Team Training (ESMTT): Fairfax, Virginia*

To test if the Internet of Things (IoT) approach can improve disaster and emergency team training, the ESMTT team conducted a complex, live, training drill that transmitted sensor data from a first responder team at a simulated accident site to a medical/surgical team at INOVA Fairfax Hospital. Dozens of Bluetooth proximity beacons, activity sensors, and ultra-small microcomputers were deployed on EMTs, firefighters, victims, equipment, an ambulance, and other components. The sensors were wirelessly connected to a cloud-based data analytics system that captured, analyzed, transmitted, and displayed the data to emergency room doctors and surgeons waiting to receive the patient. Sensor data provides a window into the movements and actions of individuals and teams in relation to the accident victim. ESMTT will continue to refine the technology and its effectiveness in team-based learning to improve the delivery of patient care.



PARTNERS: George Mason University, Yet Analytics, Advanced Distributed Learning Co-Lab, Advanced Surgical Technology Education Center and Emergency Department, INOVA Fairfax Hospital, Arnouse Digital Devices Corporation, and Fairfax County Fire and Rescue.

CONTRIBUTORS: B-Line Medical, Georgetown University, Learning Analysis Research Corporation, Montgomery County Thingstitute, University of Maryland

Photo Courtesy of Project Team.



## Global City Teams Challenge EXPO

### *Remotely Caring for Vulnerable Populations during a Pandemic*

This project demonstrates the transformational power of open, integrated, medical device and HIT platforms to automate detection, triage, and treatment of individuals affected by a pandemic. For this scenario, multiple organizations demonstrated various methods over 20 days to improve Ebola care, inter-vendor data sharing, device integration, and remote and closed-loop control to provide capabilities beyond those available today to improve patient care and protect healthcare workers. The demonstration integrated sensors and data acquisition to improve Ebola screening, monitoring, and diagnosis; remotely controlled of ventilators, infusion pumps, and monitors; integrated multiple sensors for quarantine monitoring; tested remote monitoring; and used sophisticated data processing and visualization to improve patient care and reduce the exposure of hospital personnel by limiting the number of times healthcare workers enter the patient environment. For GCTC additional technology was used to screen individuals at home for conditions such as the flu, diarrheal diseases, and Ebola.



**PARTNERS:** Open ICE, which includes Massachusetts General Hospital, Harvard Medical School (MGH/HMS), FDA / CDRH, FCC, Intel, GE, US Critical Illness and Injury Trials Group, Worcester Polytechnic Institute, IEEE, Smiths Medical, Respiratory Motion, Lyntek, Zephyr / Covidien, DocBox, Philips, US DoD / MEDCOM, US DoD / TATRC, Dräger, Industrial Internet Consortium, Qualcomm Life, and LNI.

*Photo Courtesy of Project Team.*

### *Safe Community Alert Network (SCALE): Montgomery County, MD*

The Safe Community Alert (SCALE) network seeks to bring the safety and security of connected devices to everyone, regardless of their financial means or technical savvy. This showcases a new network of public safety with a diverse ecosystem of devices, standards, and connectivity options. The SCALE network, currently being demonstrated in a senior living facility in Montgomery County Maryland, senses hazardous air and water factors as well as some facets of the physical health and well-being of resident volunteers. This real world test bed has deployed environmental sensors to detect a variety of factors including: smoke, carbon dioxide and monoxide, some toxic gases, humidity, temperature, particulates, and some forms of pollen. Sensors also detect water consumption and contaminants. The data compliments information related to the health of a resident that comes from health devices such as blood glucose monitors, heart monitors, and oxygen machines. It can even detect events such as falls, unauthorized access to sensitive areas, or a resident that has wandered off. Data collected from sensing of events goes to the SCALE platform where applications can then be built. The SCALE network contains a text message notification system, automatically initiated conference calls with family and care providers, dashboards for first responders, and analytics for public health officials, all with affordable forms of technology and connectivity.



**PARTNERS:** Montgomery County, UC-Irvine, Brivo Labs, IBM, AT&T, Intel, Victory Housing, SigFox, N5 Sensors, Senseware, TATRC, Captiva, Twilio, Earth Networks, UT-Dallas, IoT Dev Labs, Intel Security, Massachusetts General Hospital/Harvard Medical School, MIT, IoT DC Meetup, and the University of Maryland.

*Arte Courtesy of Project Team.*



### *People, Energy and Buildings: Flagstaff, AZ*

The goal of this project is to demonstrate how smart cities technologies and urban informatics can positively impact the well-being of communities—the safety, health, and productivity of people. Distributed, connected, and intelligent infrastructure is an entirely new kind of infrastructure that can both improve existing services and enable entirely new services to support both quality of life and the robust, sustainable growth of local economies. Our strategy is to first demonstrate short-term impact, and then, in the long term, design and deploy enabling smart cities technologies for multiple applications. The first stage will demonstrate the value of urban informatics technologies in several applications. One application exploits existing wireless sensing infrastructure to infer the thermal energy flows of buildings. The second application, pending additional funding, integrates sensing of building environment and personal comfort to improve productivity and energy efficiency. The third application targets data-driven predictive analytics for population health using distributed sensing of air quality.



PARTNERS: Northern Arizona University, City of Flagstaff, Economic Collaborative of Northern Arizona (ECoNA), and Northern Arizona Center for Entrepreneurship and Technology.

*Photo Courtesy DPC.*



### ARTS AND EDUCATION

#### *Bringing Internet of Things Know-How to High School Students*

Today's students will be building and living in the smarter cities and communities of tomorrow.

They'll be designing and using objects that contain tiny sensors and miniature computers to continuously take data measurements about the surrounding environment, helping to create an interconnected Internet of Things (IoT). This project is creating IoT experiments and making them available to high school students across the country so they can learn about the technologies, applications, and issues related to the IoT and gain critical know-how. Students and teachers will learn how to build hardware and software to collect, analyze and compare real-world sensor data. Data is then shared through a real-time data bulletin board with access to all regardless of location. Hardware and sensor kits were developed for the project using low-cost computer boards including Raspberry Pi, BeagleBone Black and Galileo, along with a modular system of interchangeable sensors and actuators to measure temperature, sound, motion, and other factors. Prototypes have been created of IoT paper flash cards that are used to help explain core concepts and identify the components needed for a particular sensor application.



**PARTNERS:** Internet of Things DC, IoT Dev Labs, Arlington County Virginia, Virginia Tech, Montgomery County Maryland, Earth Networks / WeatherBug, Texas Instruments, Intel, Centeye, Oregon State University, George Mason University, Cisco, Think Big Partners, and high school students, STEM educators and volunteers from locations across the United States.

*Photo Courtesy of Project Team.*

#### *Smart City Educational Network for Autistic Students: Stillwater, OK*

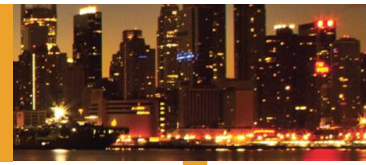
The team showcased resources to improve educational opportunities for autistic students. It involves developing a cyber-physical technology-based demonstration test bed involving cyber and physical tools to support learning among children with autism, using ultra-fast high gigabit networks to help cyber learning activities for autistic students. CPS and the IoT can support city schools and school districts by improving the quality of services provided to children with special needs, which can in the long term reduce overall costs for these services. Smart Cities are not sustainable without an emphasis on providing educational services. The team works with schools, parents, teachers to help students learn from a variety of resources from their homes and from any other location (irrespective of where they are). For autistic students, prior work in use of virtual technologies and ultra-fast networks can play a key role in developing new cyber physical tools to support learning for these children with special needs.



**PARTNERS:** Oklahoma State University, City of Stillwater, Stillwater Public Schools, and University of Wisconsin Madison.

*Photo Courtesy DPC.*





## Smart Strijp-S: Eindhoven, The Netherlands

Strijp-S is the creative and cultural area of Eindhoven and is at the heart of economic, cultural, and technological initiatives. The project goal is to update Strijp-S to cover the entire spectrum of art, technology, research and development chain, cultural production and presentation on Strijp-S. The backbone of the project is a system of complex hardware and software that monitors and controls the street lighting, mobility, homes, offices, etc. of the 'smart city'. The backbone makes it possible to monitor and control the innovative lighting installations of Light-S (i.e., smart street lighting system). An advanced network connects new projects, applications, the environment, and people. The system is one of the key enablers of the Living Lab concept, supporting the iterative learning and development cycle for the innovative smart city installations. The network creates a deeper insight of dynamic changes in the environment by connecting hardware and software and providing smart data management.



**PARTNERS:** City of Eindhoven, Politie, RTR-NL, Atos, intel, University of Technology Eindhoven, Philips, and DITSS.

*Photo Courtesy of Project Team.*

## Resource Network for Early Childhood Care and Education: Baltimore, MD

This project aims to assist parents and childcare providers in nurturing their children's development and preparing them for successful entry into kindergarten. The Resource Network will establish an interactive childcare portal—delivered via smartphone, tablet, or computer—to connect parents and caregivers with local childcare resources and agencies, and enable the formation of social networks among parents, family members, pediatricians, and childcare services. The pilot is a smartphone-based application in an inner-city neighborhood of Baltimore, Maryland that enables parents to connect via their smartphones to local childcare resources, to schedule and attend medical appointments, and to develop and maintain relationships with childcare services. The outcome is a networked referral system that automatically matches parental needs to community resources to improve the efficiency of pediatric and child health service delivery. One goal is reducing costs to the hospital system that occur due to missed appointments, late diagnoses and interventions, and unsatisfactory parental experiences. The project addresses a lack of infrastructure to deliver quality childhood care and education that is accessible and affordable to all families. This need is particularly acute in underserved communities that lack resources to support positive parenting skills and quality early childhood experiences.



**PARTNERS:** Aethena Group, LLC, TCecure, YMCA, Maryland Family Network, City of Baltimore, and University of Maryland School of Medicine, Infants and Toddlers Program Baltimore.

*Art Courtesy of Project Team.*



## Global City Teams Challenge EXPO

### NSF Early Career Workshop Teams

The team showcased two projects, one related to an effort to provide resources to the city's homeless population more efficiently. The goal is to achieve smarter delivery of community service through population sensing and urban technologies, using advanced mathematical modeling and urban technologies to balance the supply and demand. The system would distribute resources at strategic locations, with real-time coordination, and maximize the welfare of both the homeless and other citizens. It would report supplies in real time and distribute strategically through existing and mobile channels. The second project is related to the use of sound profiles to diagnose the health of appliances and HVAC. The goal is to monitor legacy building systems and appliance conditions acoustically, in real time using a novel static and mobile sensing infrastructure. Costly commercial and industrial equipment faults can be preemptively identified in-situ, and then the relevant stakeholder can be alerted, e.g., building managers, warehouse foreman, to address the issue. Smartphone applications will be used to leverage handheld device sensors to perform domestic appliance diagnosis.

### OneCommunity: Cleveland, OH

This team will showcase Gallery One, which has brought the Internet of Things (IoT) and Big Data technology to Cleveland Museum of Art's collection making art accessible in new ways and engaging new audiences. Established as a nonprofit in 2003, OneCommunity is working to turn Northeast Ohio into a Smart Region that directs resources to support technological innovation and superb overall quality of life for citizens. At the center is OneCommunity's ultra-high-speed, fiber-optic broadband network, which provides data service for more than 2,300 public institutions such as hospitals, schools, libraries and government offices. This broadband network serves as a platform for innovation and collaboration, enabling a variety of beneficial programs and applications in health care, education, government and public safety. It is also an ideal test environment for researchers, technology companies and entrepreneurs.

☰

Donate Food

☐

Perishable

☒

Needs Refrigeration

☐

Hot

☒

Vegetarian

☐

Dairy

☐

Kosher

Your location

North Oakland

How many servings?

4

How long are you available?

90 minutes

Request Food Pickup

PARTNERS: NSF, University of California, Los Angeles, CalTech, and Carnegie Mellon.

*Photo Courtesy of Project Team.*



PARTNERS: Cleveland Museum of Art  
*Photo Courtesy of Project Team.*



## ENVIRONMENT AND SUSTAINABILITY

### *Managing Urban Air Quality: Chicago, IL*

This project is investigating how cities might optimize air quality by managing traffic flow, for instance, via schedules or temporary routing. This requires understanding of the spatial and temporal dynamics of urban air contaminants, particularly related to vehicle emissions, and in the context of diverse weather, natural topology, and built form of cities. The project leverages Chicago's Array of Things (AoT) initiative, which uses resilient embedded systems technology developed at Argonne National Laboratory. The AoT provides an urban scale testbed to embed new technologies and services in the built infrastructure, enabling application developers to access near-real time, high spatial-temporal resolution data about urban air quality, weather, and other factors. Deploying technologies in urban spaces is costly, so the project leverages existing street furniture, integrating AoT's air quality and environmental sensors into solar powered, networked waste stations built by BigBelly, a waste solutions company. BigBelly operates nearly 30,000 waste stations in cities globally, and provides a vehicle through which sensors can be deployed in many diverse urban settings. The project brings together computer science, cyber physical systems, distributed systems, and sensor systems expertise to explore technical and societal challenges and opportunities of urban-scale embedded systems in the public sphere, initially related to understanding and ultimately managing urban air quality.



PARTNERS: Argonne National Laboratory, University of Florida, NYU CUSP, BigBelly, and G2 Inc.

*Photo Courtesy DPC.*

### *Coruña Smart City: A Coruña, Spain*

Coruña Smart City Platform aims to improve environmental quality (noise, air quality), reduce greenhouse gas emissions through the Smart management of energy and traffic and reduce consumption peaks in municipal infrastructures and buildings. Coruña Smart City project is promoted by the city council of A Coruña, Spain, and EMALCSA, the city's public water company. Coruña Smart City is a unique smart city project that is based on the development of the City's "brain," a powerful and open technological platform that incorporates data, in real time, from multiple sensing devices/data sources located throughout the city. The real-time data generated by different "smart projects" in the city, can be viewed in the advanced 3D visualization tool, eVidens, which is the platform interface. The eVidens tool displays information about public works, water cycle management, weather stations, public transportation, traffic conditions, tourist information, attractions, etc. Several smart projects are being developed in different areas of the City for mobility, environment, leisure, tourism, and e-administration. These projects compound the "neurons" of Coruña Smart City, and their objective is to provide more rapid, efficient, and sustainable services to the citizens. A key component of the Coruña Smart City project is the availability and visualization of live and open data generated from the projects. Today all the public data can be consulted by citizens, enterprises, council operators, and authorities at the Coruña Smart City and Open Data web portals, and through different mobile apps. Future plans include transformation of the data into valuable information to improve decision making and the citizens' daily quality of life.



PARTNERS: City of A Coruña, Spain, and EMALCSA

*Photo Courtesy DPC.*



## Global City Teams Challenge EXPO

### **Smart Sensoring and Smart Emissions: Nijmegen, The Netherlands**

The project is exploring the reliability of low-cost sensors that have been deployed to measure environmental information including temperature, noise, and air quality indicators. The project applies an innovative citizen-sensor-network in the city of Nijmegen, and tests proof of concept.

One main question is how to obtain reliable sensor data from sensors and sensor grid networks by using a mix of existing professional, semiprofessional, and community sensor data? New, low-cost sensors are developed and implemented to measure (in a fine-grained arrangement) the spatial pattern and spread of environmental information such as temperature, noise, and air quality indicators (e.g., NO<sub>x</sub> and CO<sub>2</sub>). This dynamic dataflow is communicated in an open and unified way over the Web

in order to interconnect data, sensors, and server platforms. Citizens living and working in the area participate in the project. They are in dialogue with the city-government and scientists and participate in sessions to analyze, visualize, and interpret the data using the Maptable instrument. A consortium of technology innovators, knowledge institutes and city-government executes the pilot project. Project objectives include: an increase in public awareness; cost reduction for data collection; increased understanding of pollution throughout the city, by gathering a fine-grained picture of the measured dynamic patterns and 'clustering clouds' of noise and air pollution; and experimentation with the citizen-sensor-network (e.g., connect place-based data collection, visualize and interpret data, improve local urban-environmental quality).

### **The smart residents**

well-informed residents create solutions themselves



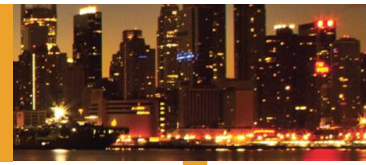
PARTNERS: INTEMO, City of Nijmegen, Radboud Universiteit, Geonovum, CityGIS, Rijksinstituut voor Volksgezondheid, Gemeente Nijmegen.

Photo Courtesy of Project Team.

### **FIWARE Binee Project - Guatemala City (Guatemala): Smart Bin and App for Rewarding/Improving Recycling in Cities**

This project rewards recycling with smart bin and app. The hardware and app solution improves recycling rates with a gamification approach through a system of rewards, education and practical information on recycling.





## CITY PLANNING AND DEVELOPMENT



PARTNERS: Austin, TX  
Photo Courtesy DPC.

### **Envision Austin – Mobile Devices for Real-Time Data and Resident Feedback: Austin, TX**

The project is leveraging mobile devices for real-time data and resident feedback to enhance urban planning and address civic priorities. As part of the Austin CituUP initiative, it enables citizens, local government, businesses, schools, and visitors to engage and interact collaboratively through digital technologies. The goal is to improve city services, transportation, safety, health, education and workforce training, economic development and many others. Data is collected through a variety of opt-in methods on personal mobile devices, fixed and mobile sensors, through micro-polling and social engagement. Data is subsequently analyzed and

evaluated for patterns, options, and to help in prioritizing city services and programs. Real time collection of data allows for a better understanding of citizen needs and aids in urban planning.

### **Lower Manhattan Smart Neighborhood Project: New York, NY**

The Lower Manhattan Smart Neighborhood pilot will create an integrated, expandable sensor network to support the measurement, integration, and analysis of neighborhood conditions, social interactions and behavior, and sustainability metrics. This pilot aims to impact and strengthen those who live and/or work in lower Manhattan by providing real-time insight into urban challenges by using noise and air quality sensing, making sensor data publicly available to support entrepreneurs and innovation, and helping, in turn, address some of the City's administration goals. The pilot neighborhood is representative of a business district neighborhood, and can be combined along with other NYC smart neighborhood projects, such as Hudson Yards, to develop quantified communities that create opportunities at the intersection of data collection, integration, and analysis at the neighborhood scale. The goal is to create a model for future urban development and planning that provides a healthy, productive, and resilient environment that responds to the changing needs and preferences

of the local community.



PARTNERS: Alliance for Downtown New York, New York University's Center for Urban Science and Progress, and the New York City Economic Development Corporation. Photo Courtesy DPC.



Bandung Command Center  
PARTNERS: City of Bandung, Indonesia  
Photo Courtesy of Project Team.

### **Bandung Command Center for Data Visualization: Bandung, Indonesia**

At the GCTC this team showcased the Bandung Command Center and its efforts to use data visualization to better serve the residents of Bandung. The Asia-Africa Smart City Alliance recently held a forum in Bandung, and generated a Bandung Declaration on smart cities. Bandung is forging ahead with technologies that will support intelligent planning decisions.



## Global City Teams Challenge EXPO

### **Living Lab Stratumseind 2.0: Eindhoven, The Netherlands**

This project aims to improve the safety, livability and attractiveness of Stratumseind and increase the street's economic and social functioning. Stratumseind is a street in the center of the city of Eindhoven, 400 meters long, with 50 pubs and many visitors (up to 20,000 per weekend). De-escalate and City Pulse are parts of “Stratumseind 2.0” and aim to improve safety. De-escalate is a research and development project focused on the influence of light on human behavior, specifically on aggressive behavior. City Pulse is a research and development project about real time data fusion between social media analytics and the Stratumseind 2.0 data. The two subprojects could lead to a system that automatically responds to data and intervenes with light scenarios. Impacts of this project include: new ways to influence attractiveness, livability, and safety in entertainment areas; economic growth in these entertainment areas; less interventions by police and guards, less safety-costs; and new products for other sectors and domains.



PARTNERS: City of Eindhoven, The Netherlands, and ATOS.

*Photo Courtesy of the Project Team.*

### **ParaDrop: Madison, WI**

How are public spaces used in a city? What are the popular spots in a shopping mall? Which transit routes are popular and how long do people wait in different stops at different times of the day? These are questions that are important to various planners of cities, malls, and public transit operators. The Paradrop project provides a unique and common platform to answer these questions. Paradrop is an edge computing platform that installs unique techniques to detect how people use various spaces in different environments. The solution is implemented in software and uses special Paradrop Wi-Fi Access Points and city-deployed sensors (e.g., audio sensors and RF sensors) to detect how busy different cafes and shops are across different times of the day, passengers use of city transit buses and stops, and many other related topics. The system is being deployed in downtown Madison, WI, in partnership with the City, a few local stores, and the local public transit service.



PARTNERS: Madison, WI, Wings Lab at the University of Wisconsin, Madison.

*Photo Courtesy DPC.*

### **FIWARE Applications – City Mobile, eGovernment Integrated and Smart City Platform, Transparency/Open Data Portal, and Recycling App: Valencia, Spain and Guatemala City, Guatemala**

At the GCTC, this team showcased the Valencia Smart City Platform (VLCi), the unifying element of their whole Smart City Strategy and a system able to manage in an effective way all the urban resources. This includes the APP Valencia, which provides the citizens with all the information about the city in real time; the eGovernment Integrated Platform, which achieves a paperless administration; and the Transparency and Open Data Platform, which involves the citizens in the city management processes. These applications are running on top of the FIWARE open platform. FIWARE is a middleware platform driven by the European Union for the development and global deployment of applications for the internet of the future. The API specification of FIWARE is open and royalty-free; involvement of users and developers is critical for the platform to become standard and reusable. The Binee Project will demonstrate a smart bin and app for rewarding and improving recycling.



PARTNERS: City of Valencia, Spain, SpeedUpEurope Accelerator, FIWARE Mundus, City of Oldenburg, Germany Energy Utility, and Guatemala City, Guatemala.

*Photo Courtesy of Microsoftflickr.com*



## Genoa Smart City Initiative: Genoa, Italy

Genoa is currently part of the Genoa Smart City initiative, which is aimed at improving the city quality of life through the sustainable economic development based on research and technology guided by the Municipality in a project of integrated planning. The Genova Smart City Association was created in 2010 to facilitate the city's transformation into a Smart City involving different partners, including research organizations, private enterprises, institutions, finance and citizens. The initiative includes five pillars: Energy (smart grid, green energy, less consumption), Transportation (intelligent transport system, information mobility building, local transport system), Buildings (smart metering, retrofitting, heating and cooling), Safety and Security (risk prevention system, video surveillance, IoT city infrastructure) and Smart Ports (automated port services). In the energy area, the ROSE project is looking at the technical and economic viability of intelligent smart and micro grid nodes, interconnected with a smart aggregator for global optimization as an effective way to implement an open, active demand/response system integrated with the Grid.



PARTNERS: Genoa, Italy

Photo Courtesy commons.Wikimedia.org

## FIWARE We Build City – Open and 3D Development Platform for Urban Planning: Koblenz, Austria

This Koblenz, Austria-based team showcased the Open and 3D City Platform (We Build City) for urban planning based on FIWARE. FIWARE is an open source, royalty-free middleware platform supported by the European Union for development and deployment of future Internet applications. FIWARE provides an open cloud-based infrastructure for cost-effectively delivering future Internet applications and services on a revolutionary scale. The “We Build City” effort is part of the SpeedUpEurope project – a ground-breaking acceleration and support program providing financial support, entrepreneurial training, innovation and financing to European SMEs and web entrepreneurs working on innovative applications and FIWARE technology. A team composed of the project coordinator and a representative from the City of Koblenz demonstrated at the GCTC how the Open and 3D City Development Platform for Urban Planning can help move cities toward efficient city planning and use of resources.



PARTNERS: Koblenz, Austria, FIWARE

Photo Courtesy Wikipedia GFDL





### TOURISM AND RECREATION

#### *FIWARE TripStories: Assisi, Italy*

A team from the “TripStories” SpeedUpEurope project showcased a smart tourism and mobility application designed to support a better environment, operating in the City of Assisi, Italy. The APP informs citizens, in real time, about everything happening in the city and disseminates the information. The project is part of an accelerator program designed to move smart open platforms into real applications in cities around the world.

#### *Mobile-First Communication and Service On-Demand Infrastructure for Hospitality*

The team showcased an initiative to utilize a dynamic data collection system to improve staff effectiveness at New York's Gansevoort hotels. Using an app to order a taxi, make a restaurant reservation, or order dinner is the birth of a new mode of interaction where services are at the touch of your fingertips. There is a clear benefit in a mobile platform that bridges the communication between consumers and service providers to deliver services faster, and with higher accuracy. Delivering effective service on demand (SoD) requires creating a seamless integration between logistics and technology. The challenge is to connect CPS on both the request and fulfillment sides of the equation, while utilizing the Internet of Things to provide deep context. This is important to hospitality industries, where hotels, hospitals, offices and others are unable to seamlessly connect clients with services through mobile devices. In a hotel, the same guest can request room service, cleaning, or concierge services. Each request must be routed to the appropriate department, monitored for completeness, and escalated if missed. Staff must have mobile devices which make them accessible in real time, and provide a simple way to respond with progress. Unfortunately this infrastructure does not exist today. For this reason, ALICE has partnered with The Gansevoort Hotel Group to build the world's first flexible SoD infrastructure that can fit the service offering of any industry or department. The impact of this technology is only limited by the needs of the industries and companies that adopt it.



PARTNERS: City of Assisi, Italy,  
SpeedUpEurope, FIWARE

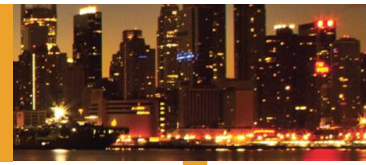
*Photo Courtesy DPC.*



PARTNERS: ALICE and Gansevoort  
Hotel Group

*Photo Courtesy DPC.*





## PLATFORMS FOR THE INTERNET OF THINGS

### *Building a Better City – Streetlights: San Jose, CA*



PARTNERS: San Jose, CA and AnyComm

*Photo Courtesy DPC.*

This San Jose, CA-based team showcased efforts to install high speed wireless networking platform with a suite of sensors and wireless capabilities on existing infrastructure. The city has initiated a pilot with AnyCOMM, an IoT start-up that makes Wi-Fi connected devices (nodes) that can collect volumes of data from city streets. The data can be stored, sorted and returned to city officials in order to help improve planning and public safety. The nodes will be installed along city roads, and are equipped with sensors, smart-meter chips, high-speed Internet and mobile phone chips. Nodes will have the ability to sense movement on the streets and send alerts during specific types of events. An example is the trembling of an earthquake. The nodes can serve as Wi-Fi hot spots and potentially turn off streetlights when sidewalks are empty to reduce energy consumption.



PARTNERS: Extreme Networks, US Ignite, University of California, Irvine

*Photo Courtesy DPC.*

### *Extreme Networks #1: Team UCI DSM*

Mission-critical applications in Public Safety, Environmental/Earth Sensing, and Healthcare Monitoring need to run on highly resilient network infrastructure. To address this challenge, Team UCI DSM is building an SDN application for unified end-to-end management of sensors and traditional infrastructure network.

### *Extreme Networks #2: Team MarTech*

There is a substantial need to empower the next-generation of network engineers to validate their ideas on real-world networks. Team MarTech

will demonstrate an SDN application for real-world network emulation in research and education labs. Users of this application will have the ability to inject network problems artificially to study the impact on applications. They can also test new topology ideas without having to worry about breaking the network.

### *Extreme Networks #3: Team FlowGuard*

SDN creates intelligent networks by making them dynamically programmable to the needs of applications enabling communications, IoT and more. Dynamic programmability is a double-edged sword because it may also expose the network to new security violations caused by dynamic packet modifications. Team FlowGuard will demonstrate a robust Firewall Virtualized Network Function (VNF) for SDN networks that will act both as a packet filter and an end-to-end policy checker for security vulnerabilities.



## Global City Teams Challenge EXPO



**PARTNERS:** New York City and Qualcomm

*Photo Courtesy DPC.*

### *Link NYC High Quality Wi-Fi: New York, NY*

This New York, NY-based team will showcase a system designed to provide high-quality Wi-Fi services to millions of New Yorkers and will generate revenue in the city. Link will combine free public Wi-Fi (up to gigabit speeds), accessible communications (free nationwide calling), emergency services (911), city services (311 for way finding, utility payments, etc.) and digital displays for advertising and public service announcements. It will create the world's fastest, free municipal Wi-Fi in all five boroughs of New York, spanning the divide between people of physical, technical, and financial abilities. The new system will create 100-150 new jobs, enhance public safety, and provide revenue for New York City. City agencies will also be able to communicate in real-time with the public.



## APPENDIX B. IMPORTANT LINKS

NIST Global City Teams Challenge

<http://www.nist.gov/cps/sagc.cfm>

Global City Teams Challenge Website on US Ignite

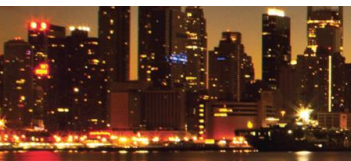
[www.globalcityteams.org](http://www.globalcityteams.org)

Global City Challenge 2015 Presentations

<https://goo.gl/36f46t>

Global City Challenge 2015 Expo Webcast

<https://www.youtube.com/watch?v=tLnFbLS4AtY&list=PLLiocXmoHP8iQBmCdGnnILPLAyPMAojYF>



# APPENDIX C. LIST OF SPEAKERS

## GLOBAL CITY TEAMS CHALLENGE KICKOFF

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**September 20-30, 2014**

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### Opening Plenary

- *Howard Harary, Director of the Engineering Laboratory, National Institute of Standards and Technology (NIST)*
- 

### Overview

- **Overview of Global City Teams Challenge**  
*Sokwoo Rhee, Associate Director for Internet of Things and Cyber-Physical Systems, NIST*
  - **Executive Office Perspectives**  
*Nick Maynard, Assistant Director for Telecommunications Innovation, White House Office of Science and Technology Policy (OSTP)*
  - **Facilitating Community Connections**  
*Glenn Ricart, Chief Technology Officer, US Ignite*
- 

### Perspectives

- **Federal Initiatives in Smart Communities and the Internet of Things (IoT)**  
*Perspectives offered by government officials advancing current and future IoT programs and initiatives*
    - *Maria Roat, Chief Technology Officer, US Department of Transportation*
    - *Janice Corbett, Executive Director, Office of Africa and the Middle East, International Trade Administration*
    - *David Corman, Program Director, Cyber-Physical Systems, National Science Foundation*
    - *Vinay Pai, Program Director, Biomedical Imaging Informatics, National Institute of Health*
    - *Kerry Cheung, Office of Electricity Delivery and Energy Reliability, US Department of Energy*
  - **Investing in Future Smart Cities and IoT**  
*Insights and pathways for building successful and sustainable partnerships*
    - *Team SCALE: Dan Hoffman, Chief Information Officer, Montgomery County, Maryland*
    - *Team ARIBO: Corey Clothier, Chief Executive Officer, Comet Consulting*
- 

### Partner Presenters:

- **Leo Kenny, Senior Materials Development Engineer, Intel**
  - **Dion Rudnicki, VP, Government Solutions and Growth Initiatives, IBM**
  - **John Orbe, VP and Managing Director SLED Americas, Juniper**
  - **Rick Freeman, CEO, Intelligent Cities, GE**
  - **Stephen Patterson, VP, Public Affairs, ARM**
  - **John Baekelmans, CTO, Internet of Everything Solutions Group, Cisco**
  - **Steve Crout, VP, Government Affairs, Qualcomm**
-





## GLOBAL CITY TEAMS CHALLENGE TECH JAM

**February 12-13, 2015**

### Day 1 Opening Remarks

**Welcome** *Richard Cavanagh, Acting Associate Director for Laboratory Programs and the Director of the Special Programs Office, National Institute of Standards and Technology (NIST)*

**Global City Teams Challenge Overview:** *Sokwoo Rhee (NIST) and Glenn Ricart (US Ignite)*

### Keynotes

*Dan Correa, Senior Advisor for Innovation Policy, White House Office of Science and Technology Policy (OSTP)*  
*Jon Bruner, O'Reilly Media, Co-Chair of Solid Conference*

### Special Remarks

*Ike Leggett, County Executive of Montgomery County, MD*

### Federal Program Opportunities for Smart Communities and the Internet of Things (IoT)

*Perspectives offered by government officials on current and future program opportunities*

- *David Corman, National Science Foundation*
- *Walter Fehr, US Department of Transportation*

**Action Cluster Panels – Scenarios for Global Cities** *Perspectives from Global City Action Cluster Teams – current/future work, partners needed, expected outcomes and challenges:* **Disaster Resiliency, Transportation, General, Education**

### Day 2 Opening Perspectives

*Chris Greer, Director of Cyber-Physical Systems and Smart Grid Program Office (NIST)*

### Keynote

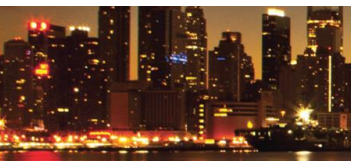
*Richard Voyles, Assistant Director of Robotics and Cyber-Physical Systems (OSTP)*

### International Efforts in Global Cities

*Bram Reinders, Amsterdam Smart City*  
*Noa Pereg, Head of Media, Tel Aviv*

## Action Cluster Presentations February 12, 2015

| Primary Sector: Disaster Resilience  | Presenters                                 |
|--|--|
| Human Population Mapping for Enhanced Community Resilience (Annapolis Team)    | Tina Williams, TCecure, LLC                |
| Smart Emergency Response System (SERS)   | Shengli Fu, University of North Texas      |
| Cyber Attack-Defense Exercise for System Planners and First Responders (Iowa)  | Manimaran Govindarasu, Iowa State          |
| Real-Time Geospatial Collaboration Platform for First Responders               | Chris Philips, TouchShare                  |
| Using Dynamic Virtualization and Intelligent Edge Devices in Disaster Response | Jeff Christensen, Entry Point              |
| Integrating an Aerial Base Station with a City's Emergency Communication Grid  | Kamesh Namuduri, University of North Texas |
| Primary Sector: Transportation   | Presenters                                 |
| Smart Mobile Operation: the OSU Transportation Hub (SMOOTH): Columbus, OH      | Paul Carlson, City of Columbus, OH         |
| Connected, Intelligent Transit (Portland)                                      | Adrian Pearmine, IBI Group                 |
| ARIBO: Applied Robotics for Installations and Base                             | Corey Clothier, Comet Consulting           |



## Global City Teams Challenge EXPO

|  |   |
|--|---|
| <b>Operations</b>  |   |
| Greenville A-Taxi Shuttle Project  | Fred Payne, County of Greenville, SC            |
| <b>Primary Sector: General</b>   | <b>Presenters</b>                               |
| Lower Manhattan's Smart Neighborhood Pilot   | Sander Dolder, NYCEDC                           |
| PlanIT Impact (Kansas City)  | Kari Keefe, Mozilla Foundation                  |
| Kumbh Mela: Solving the Problems of Millions (Camera Culture Group At MIT and Nashik)        | John Werner, MIT Media Lab                      |
| Mobile-first Communication and Service On Demand Infrastructure for Hospitality - ALICE (NY) | Sam Evers, ALICE                                |
| ParaDrop   | Suman Banerjee, University of Wisconsin-Madison |
| NYCLink  | Steve Crout, Qualcomm Government Affairs        |
| <b>Primary Sector: Education</b>   | <b>Presenters</b>                               |
| Bringing Internet of Things Know-How to High School Students                                 | Greg Toth, Internet of Things Dev Labs          |
| SENAS: Smart City Educational Network for Autistic Students                                  | J. Cecil, Oklahoma State University             |

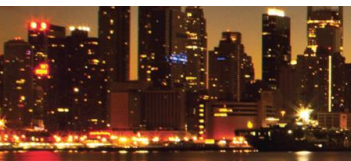
### Action Cluster Presentations February 13, 2015

|   |  |
|---|--|
| <b>Primary Sector: Health &amp; Public Safety</b>                                     | <b>Presenters</b>  |
| Remotely Caring for Our Most Vulnerable Citizens In-Place During A Pandemic           | Julian Goldman, Mass General Hospital and Harvard Medical School   |
| PA 2040 (DC)  | Mamta Sodikumar, OCTO, Ted Jutras, Golden Triangle BID, Ken Walton, NCPC   |
| SCALE: Safe Community Alert Network   | Dan Hoffman, Montgomery County, MD   |
| Smarter Sockets: Indoor Emergency Response Locators                                   | Emmanuel Azih, Smarter Sockets   |
| Ecosystem for Smart Medical Simulation Team Training                                  | Brenda Bannan, George Mason University<br>P. Shane Gallagher, Learning Analytics Research Corp Shelly Blake-Plock, Yet Analytics, Inc. |
| Energy Efficient Data Collection Street Light Post Assembly                           | Bridget LaFemina, Pennsylvania Globe Gaslight Co   |
| Managing Urban Air Quality (Chicago)  | Katie Olson, UI Labs   |
| Chattanooga GASP: Geolocated Allergen Sensing Platform                                | David Lary, University of Texas, Dallas  |
| Friday, February 13, 2015: 11:00am-12:30pm  |  |
| <b>Primary Sector: Energy &amp; Utilities</b>   | <b>Presenters</b>  |
| Project X: GigaBit SMART City Project (Highland, IL)                                  | William Hadala, iWire365   |
| SmartCities Utility Infrastructure  | Ed Davalos, AT&T   |
| Intelligent Connectivity & Water Resource Management                                  | Steve Crout, Qualcomm Government Affairs   |
| Project Healthy Smart City  | Subrahmanian Eswaran, Carnegie Mellon University   |
| 5D Smart San Francisco 2030 District  | Michael Jansen, Cityzenith   |
| Energy Storage based Adaptive Demand Response in Smart Commercial Buildings (NYSERDA) | Christoph Meinrenken, Columbia University  |
| Distributed Mobile Storage for Resilience – Plugin Electric Vehicles (PEVs)           | Patrick Murphy, Reluminati   |
| <b>Primary Sector: Education</b>  | <b>Presenter</b>   |
| Resource Network for Early Childhood Care and Education                               | Michael Dunaway, The Aethena Group   |



## APPENDIX D. ACRONYMS

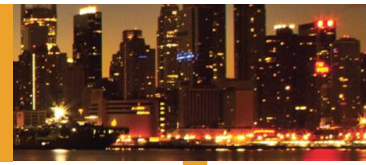
|                 |  |
|-----------------|--|
| µm              | micrometer   |
| 3D              | 3 dimensional  |
| 5D              | 5 dimensional  |
| AoT             | Array of Things  |
| ARE Liguria     | Agenzia Regionale per l'Energia della Liguria                |
| ARIBO           | Applied Robotics for Installation and Base Operations        |
| BAS             | Building Automation Systems                                  |
| CCAT            | Connecticut Center for Advanced Technology                   |
| CCI             | Chesapeake Crescent Initiative                               |
| CEO             | chief executive officer                                      |
| CIO             | Chief Information Officer                                    |
| CISE            | Computer and Information Science and Engineering             |
| CO <sub>2</sub> | carbon dioxide   |
| CPS             | Cyber-physical systems                                       |
| CT DECD         | Connecticut Department of Economic and Community Development |
| CTO             | Chief Technology Officer                                     |
| CUNY            | City University of New York                                  |
| CVPC            | Connected Vehicle Proving Center                             |
| DARPA           | Defense Advanced Research Projects Agency                    |
| DDOT            | District Department of Transportation                        |
| DETER           | Cyber Defense Technology Experimental Research               |
| DHS             | U.S. Department of Homeland Security                         |
| DITSS           | Dutch institute for Technology Safety & Security             |
| DMPED           | Deputy Mayor's Office for Planning and Economic Development  |
| DOD             | U.S. Department of Defense                                   |
| DOE             | U.S. Department of Energy                                    |
| NREL            | National Renewable Energy Laboratory                         |
| DOT             | U.S. Department of Transportation                            |



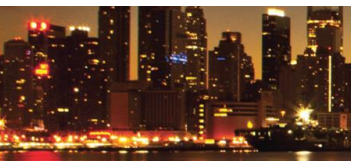
## Global City Teams Challenge EXPO

|            |   |
|------------|---|
| DR         | demand response   |
| DTU        | Technical University of Denmark   |
| ECoNA      | Economic Collaborative of Northern Arizona                              |
| EMALSCA    | Empresa Municipal de Aguas de La Coruna, S.A.                           |
| EMT        | Emergency medical technician  |
| EOSDIS     | Earth Observing System Data and Information System                      |
| EPFL       | École Polytechnique Fédérale de Lausanne                                |
| ERDF       | European Regional Development Fund                                      |
| ESMTT      | Ecosystem for Smart Medical Team Training                               |
| FAA        | Federal Aviation Administration   |
| FCC        | Federal Communications Commission                                       |
| FDA / CDRH | Food and Drug Administration Center for Devices and Radiological Health |
| FHWA       | Federal Highway Administration  |
| GASP       | Geolocated Allergen Sensing Platform                                    |
| GCTC       | Global City Teams Challenge   |
| GE         | General Electric  |
| GT BID     | Golden Triangle Business Improvement District                           |
| HGM        | Human Geography Mapping   |
| HIT        | Health Information Technology   |
| HMS        | Harvard Medical School  |
| HVAC       | heating, ventilation, and air conditioning                              |
| IEEE       | Institute of Electrical and Electronics Engineers                       |
| IoT        | Internet of Things  |
| IP         | Internet protocol   |
| IPCC AR5   | Intergovernmental Panel on Climate Change Fifth Assessment Report       |
| IT         | information technology  |
| ITA        | International Trade Administration                                      |
| LED        | light emitting diode  |
| LTE        | Long-Term Evolution   |
| MGH        | Massachusetts General Hospital,   |
| MIT        | Massachusetts Institute of Technology                                   |
| MOSI       | Museum of Science and Industry (Tampa, FL)                              |





|                 |   |
|-----------------|---|
| NASA            | National Aeronautics and Space Administration                   |
| NCPC            | National Capital Planning Commission                            |
| NDFD            | National Digital Forecast Database                              |
| NERC            | North American Electric Reliability Corporation                 |
| NIH             | National Institutes of Health                                   |
| NIST            | National Institute of Standards and Technology                  |
| NOAA            | National Oceanic and Atmospheric Administration                 |
| NO <sub>x</sub> | nitrogen oxides   |
| NSF             | National Science Foundation                                     |
| NY-BEST         | New York Battery and Energy Storage Technology                  |
| NYSERDA         | New York State Energy Research and Development Authority        |
| NYU CUSP        | New York University Center for Urban Science and Progress       |
| OCTO            | Office of the Chief Technology Officer                          |
| OSTP            | Office of Science and Technology Policy                         |
| OSU             | Ohio State University   |
| PA              | Pennsylvania Avenue   |
| PEV             | Persuasive Electric Vehicle                                     |
| PEVs            | Plugin Electric Vehicles  |
| PSAP            | Public Safety Answering Point                                   |
| PTZ camera      | pan-tilt-zoom camera  |
| PV              | photovoltaic  |
| R&D             | research and development  |
| RCP             | Representative Concentration Pathway                            |
| ROI             | return on investment  |
| SCALE           | Safe Community Alert Network                                    |
| SDN             | software-defined networking                                     |
| SERS            | Smart Emergency Response System                                 |
| SIM             | seismic and infrastructure monitoring                           |
| SMOOTH          | Smart Mobile Operation Ohio State University Transportation Hub |
| SoD             | service on demand   |
| SSP             | Shared Socio-economic Pathways                                  |
| STEM            | science, technology, engineering, and mathematics               |



## Global City Teams Challenge EXPO

|                     |  |
|---------------------|--|
| sUAS                | small unmanned aircraft system                                   |
| TARDEC              | Tank Automotive Research, Development and Engineering Center     |
| UAV                 | unmanned aerial vehicle  |
| USC/ISI             | University of Southern California Information Sciences Institute |
| USGS                | United States Geological Survey                                  |
| UTARI               | University of Texas at Arlington Research Institute              |
| VLCi                | Valencia Smart City Platform                                     |
| VP                  | vice president   |
| Zn-MnO <sub>2</sub> | Zinc- Manganese dioxide  |